Cat. 1 P.9

REPORT

OF

PROCEEDINGS

MEETING OF THE TRUSTEES

WESTERN WHITE PINE BLISTER RUST CONFERENCE

HELD IN

PORTLAND, OREGON

November 4, 1927.

REPORT OF PROCEEDINGS, MEETING OF TRUSTEES

of the

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NOVEMBER 4, 1927.

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The meeting was called to order by Chairman Charles A. Park at 10:05 A.M.

First order of business was a report of the Secretary-Treasurer. Mr. Chapman called attention to the departure from the 10-year program made necessary a year ago on account of the spread of the rust into Oregon. At that time an increase of $73,000 over the program estimate of $200,000 was made and the appropriation as it finally passed amounted to $260,000, this being the amount of money made available for the 1928 fiscal year.

As to finances of the Conference, Mr. Chapman stated that there was still a small balance in the treasury, part of the money collected several years ago still being available. The present balance being $131.80.

Communications from Mr. Barss, from Mr. Lord, Director of the Budget, and Messrs. Jensen, Taylor and Nash were read. The next order of business was report of Mr. Wyckoff, in charge of the field work, Western Office of Blister Rust Control. Mr. Wyckoff gave the following summary of blister rust control in the Far West.

PROGRESS OF BLISTER RUST CONTROL IN THE WEST

by

Stephen N. Wyckoff.

A. Cultivated Black Currant Eradication:

This work has been finished in Montana, Idaho, Washington and Oregon. Approximately 2/3 of the State of California is finished. At least two more field seasons with an annual expenditure of approximately $7000 will be necessary to go over the remaining ground in California. Some re-checking work in all states may thereafter be necessary.

B. Local Control:

(1) Experimental local control on national forest lands of north Idaho and adjacent territory: This work has been carried on since 1922. The accomplishments to date may be briefly summarized as follows:

(a) The development of a field organization, supervisory personnel and necessary equipment to put into the field at any future date a force of 200 men.

(b) The development of methods of Ribes eradication whereby the average cost per acre over any large area will vary from $1.25 to $2.50 per acre.

The cost for 1926 was $1.26 per acre on an area containing an average of 43 Ribes per acre. The cost in 1927, on an area of approximately the same degree of accessibility, but representing rather more difficult working conditions and containing an average of 122 Ribes per acre was $2.33 per acre.

(2) Experimental local control in the sugar pine region of California.

This work has been under way for two seasons. The results to date consist of the development of a small but efficient organization and suitable supervisory personnel to conduct experimental work on any scale thought desirable in the future: the delimitation of eradication types and the development of Ribes eradication methods suitable to the conditions encountered on the Stanislaus National Forest, recognized by the Forest Service as lying within the optimum range of sugar pine. The cost of this work to date has varied between $2.00 and $2.50 per acre; this experimental work is, however, in its early stages and it is therefore expected that these costs will be decreased.

(3) Control reconnaissance of white pine type in northern Idaho and adjacent territory:

(a) National Forests. Areas on the Kaniksu, Pend Oreille, Coeur d'Alene and St. Joe National Forests have been reconnaissanced and mapped. This work has been carried out in cooperation with the Forest Service, and is based upon the best possible use of all Forest Service timber reconnaissance data.

(b) In cooperation with the timber protective associations of north Idaho, control reconnaissance has been conducted on areas selected by the associations as representing high white pine values.

(c) Extensive surveys have been made of the white pine type situated in Pend Oreille and Stevens counties, northeastern Washington.

(d) Surveys have also been made on numerous parts of the white pine type in northwestern Montana.

It is the feeling of this office that two more years of this type of reconnaissance will give us a sufficiently broad basis for the development of general local control plans. During the course of this work the cost per acre of reconnaissance has been reduced from approximately 10¢ to approximately 3¢ per acre. This has been made possible by better field organization and working methods better suited to the job.

(4) Control reconnaissance in the sugar pine region in California: this work has been under way for two seasons. The Stanislaus National Forest has been sufficiently covered so that no further work there will be necessary. It is planned to conduct similar work on the Plumas National Forest next summer. With field methods fairly well developed it should in the future, be possible to cover all the sugar pine type in any one of the national forests in one season by the annual expenditure of approximately $10,000. As in Idaho, this work is receiving material assistance from the Forest Service.

C. Specialized Experimental Work Leading to the Development of Better Local Control Practices:

(1) Experimental chemical eradication. Experiments to determine the feasibility of chemical eradication have been under way for four seasons. A very small study was made at first but due to the success attained, the work was constantly increased in scope. We are now in a position to definitely state that R. petiolare, one of the three species of Ribes which frequently occurs in great numbers in stream bottoms of the white pine type and which is so susceptible to the blister rust that it will constitute a very serious menace to nearby pine stands, can be much more effectively and cheaply eradicated by means of chemicals than by hand pulling. The estimated saving of chemical eradication over hand pulling is at present 35% to 50%. Intensive investigational work now under way shows a probability that the present cost of chemical eradication can be materially decreased without the loss of any efficiency. We believe that further research and experiment will produce as good results with other species of Ribes growing in large concentrations as have been obtained with R. petiolare. With the headway which has been made on this particular line of experimental work the prospect is bright that the future standard method of eradicating Ribes in stream bottoms where they grow in great profusion will be by the application of chemicals rather than by slow, expensive, and relatively inefficient hand pulling. When this method is further developed it will materially decrease the average costs per acre which are now being secured by hand pulling. Up to the present time an unduly high proportion of the total cost of hand eradication has been tied up in the work in stream bottoms.

(2) Studies in Ribes ecology. Field studies in Ribes ecology to secure basic information of value to local control practices and to determine the feasibility of decreasing the Ribes flora of the white pine type by means of forest management have been under way for four years. The results obtained during this period indicate that the studies can be made of major value to the development of local control practices and that there exists a real possibility of at least partially decreasing the Ribes flora of the forest by means of management. The high lights of the results thus far obtained (and further study is required before exact statements can be made) are as follows:

(a) Reasonably well stocked forest stands in the white pine type tend to free themselves from Ribes growth with increasing age. This may be due to increasing shade on the forest floor, to root competition, or some other factor not yet recognized. The results of this action, whatever the cause may be, is that the older bushes very gradually die out and none or very few young ones start.

(b) The data now available strongly indicate that Ribes seeds are not disseminated over long distances but that they may remain viable in the duff for long periods and will germinate when the proper conditions are set up. The significance of this is that if Ribes are uprooted from an area before seeding, it will mean a steadily decreasing number of seedlings until the ground becomes practically Ribes free.

(c) Most disturbances of the ecological conditions of a normal well stocked forest are immediately followed by a heavy growth of Ribes. Such a Ribes growth may be caused by mechanical disturbances of the duff, to logging or road building, or to forest fire. In this connection, however, it should be pointed out that the severity of the forest fire is a factor of major importance in the subsequent development of the Ribes flora. In general, it can be stated that a fire which is so hot as to destroy the possibility of white pine reproduction for many years will also prevent the growth of Ribes.

A report, however brief, upon the status of the work is incomplete without a statement regarding the spread of the rust. The 1927 growing season has proved to be very favorable for the spread of white pine blister rust. The white pine stands of the Inland Empire have now been directly invaded, as proved by the finding of infection on Ribes 7 miles north of Priest River, Idaho, and numerous infections in northeastern Washington. The development and intensification of the rust in the coast region of Washington has reached such a point that from now on a large volume of aeciospores will be produced to hasten southward spread of

the rust on Ribes. Numerous infections on Ribes have been found in northwestern counties of western Oregon which appear to be due to a heavy but unknown source of pine infection in the general vicinity of Mt. St. Helens, Washington. A small pine infection center was found at Spirit Lake on the north slope of Mt. St. Helens. It is very likely that pine infection has been established in northwestern Oregon during the present season as a result of the extensive Ribes infection there.

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At this time there were a number of questions asked Mr. Wyckoff concerning the progress of the work. Mr. Chapman asked particularly as to what chance there was for spot control, i.e. a leaving of the less susceptible species of Ribes. Mr. Wyckoff stated that their investigation so far indicated that a preliminary survey of any tract might show that some of the less susceptible species might be left with safety. Mr. Cowan made the suggestion that to explain the present situation to interested persons a copy of the map prepared by Mr. Wyckoff's office and showing the spread of the disease might be very helpful. Mr. Wyckoff agreed to furnish the Secretary copies of the map on a small scale to use for this purpose.

The next order of business was a paper by Mr. Lachmund representing the Office of Forest Pathology, of the Bureau of Plant Industry. Mr. Lachmund covered the investigative work being done by his Bureau in the following paper:

INVESTIGATIVE WORK
OFFICE OF FOREST PATHOLOGY_
by
H. G. Lachmund.

Investigations in 1927 were continued along the lines followed in 1926 and embraced in addition work on several new and supplemental studies. The subjects under consideration were:

1. General development and spread of rust and factors influencing this.
2. Susceptibility of Ribes (currants and gooseberries).
3. Test of susceptibility of Ribes species most important in the commercial range of sugar pines.
4. Pine infecting power of Ribes species.
5. Damage to western white pine.
6. Degree of infection and prospective damage in trees of the larger size classes.
7. Susceptibility of sugar pine and other species of white pines.

Studies under 3, 4, and 6 together with extension of the studies under 2 and 7 were new projects for which provision was made thru the efforts of the Conference last year.

The bulk of the season's work was required in the studies of general development, spread and influencing factors, susceptibility of important Inland Empire Ribes associates of western white pine, and infection and damage in large size classes of western white pine.

General Development of the Rust in 1927

The year 1927 was characterized by exceptionally favorable early season conditions for spread from pines to Ribes. At pine-infection localities in British Columbia production of aeciospores was luxuriant generally. In the coastal region this was sustained more or less continuously from late April to early June. It started first in the infection localities near sea level and ended latest in those at the higher elevations, reductions in sporulation in the former being compensated by increases in the latter. In the heavy pine infection centers of the interior, maximum sporulation occurred in the middle and latter part of May. During these periods of maximum spore production Ribes leaves in British Columbia locally and generally were passing thru the stages of maximum susceptibility to these spores. Combined with this were frequent periods of precipitation and high humidities. The result was a heavy initial infection of Ribes in the pine infection centers and a wide spread in all directions from the sections of pine infection in general. (The extent to which this spread was traced is indicated on the map). For the first time the disease was found widely distributed on wild species of Ribes outside these sections in the Dry Belt and Cariboo Districts between the white pine belts of the coast and interior. In previous years it had been possible to find it on the cultivated black currants only and in some years the distribution was very limited even on these. This year the range of the disease in this section extended south of the International Boundary and was traced northward to a point some thirty miles north of Prince George, 120 miles farther than ever before. In the coastal region it was found to the north over 300 miles beyond the northern limits of western white pine there and 190 miles farther north than in any preceding season. Furthermore its spread this year in this section included the Queen Charlotte Islands. The southern extremity of these is situated some 90 miles off shore from the mainland, a full 200 miles north and west of the northern limits of the coastal belt of western white pine. The northern end of the islands is about 45 miles off shore opposite Prince Rupert. No white pines are known to occur anywhere upon them. These islands were scouted for Ribes infection in 1923 with negative results. The appearance of the disease there this year and its spread on the mainland may be considered the final contribution to the overwhelming mass of circumstantial evidence in favor of long distance spread from pine to Ribes to account for exceedingly rapid distribution of the disease over its present range. From this season's data it is now evident that jumps from pines to Ribes may be expected in favorable seasons over distances of two or three hundred miles.

From scouting south of the International Boundary two particularly interesting and important results have developed in connection with southward spread of the disease. First the discovery of the disease on pines near Spirit Lake in the Cascade Mountains opposite the mouth of the Columbia River and later the finding of the disease on Ribes near Priest River, Idaho, well within the western limits of the main commercial range of western white pine. Considering the first of these in conjunction with this and previous seasons' evidence on the capacity of the rust for long distance spread, there seems to be little if any hope for considerable delay before the rust will appear in the range of sugar pine. The disease may in fact be there now. In the case of the second discovery we know now that the disease has spread into the main commercial stands of western white pine. It must be borne in mind that it will yet be some time before any general and heavy distribution may become evident but the disease may be expected to appear there on Ribes with increasing frequency and before long will no doubt be found on pines.

Conditions for infection of the pines this year were apparently very favorable. There was a large production of the spores which transmit the disease from Ribes to nearby pines and during the period of this production moisture conditions were generally propitious for infection. Heavy intensification of the disease on pines in already established centers and the establishment of numerous new pine infection centers are therefore expected to mark the progress of the disease for 1927.

In connection with the long distance distribution of the disease since its inception here in the West it has been noted that the greatest seasonal spread has usually occurred to the north and east and that the progress of the rust to the southward has been relatively slower. On the basis of results at large in the present investigations a new theory may now be advanced as another reasonably probable explanation for this, in addition to that based on direction and character of the winds. During investigations of Ribes susceptibility it has become evident that the leaves are generally most susceptible to infection by aeciospores at a considerably earlier stage of development than hitherto has been thought to be the case and that for most species resistance to such infection develops very soon after, if not even shortly before the leaves have attained full size. In 1926 spring was exceptionally early. Ribes developed their leaves far earlier than in previous seasons or in the present season. The time of spore production on the pines was much less materially affected. This placed Ribes leaf development relatively much ahead of the period of maximum spore production. Moisture conditions were apparently ideal for infection. Yet infection was relatively light and spread was slight except at the higher elevations and to the north. To the north spread was wider than in any previous year. The virtual confinement of spread to a northward direction was explained on the basis that Ribes leaves at the lower elevations and to the south were generally too far advanced to accept infection readily from aeciospores by the time the main production of the latter commenced. This conclusion may be applied to southward spread in general. Even in a

late season Ribes leaves, except at the higher elevations, far to the south may pass thru the period of maximum susceptibility before heavy spore production has commenced on pines to the north. On the other hand, since this production of spores continues for a considerable time there will always be plenty of them to cause infection as Ribes leaves are developing to the proper stage to the north.

Ribes Susceptibility

Studies of Ribes susceptibility in 1927 were carried forward as in previous seasons. Thru scouting for new study localities in the early part of the season and for the disease toward the end of the season data was secured over a considerably wider range of conditions than before. The results generally tended to confirm those of previous seasons. Of the species important as associates of western white pine in the commercial range, high susceptibility and heavy production of the pine-infecting spore stage again characterized the infection on the inland wild black currant (Ribes petiolare) and smooth stemmed gooseberry (Grossularia inermis), particularly on the former, and susceptibility and spore production on the sticky and prickly currant (R. viscosissimum and R. lacustre) was relatively low.

Susceptibility Test of Sugar Pine Ribes

This fall a large quantity of root stocks and seedlings of the two outstandingly important Ribes associates of sugar pine in California were introduced to British Columbia for test. They will be set out there in sites carefully selected for the highest possible degree of similarity to those of their native range. Here they will be given a year in which to establish themselves and will then be dusted artificially with spores from infected pines in the vicinity. Sugar pines will be planted nearby and the spread of infection systematically recorded on both Ribes and pines.

Pine Infecting Power of Ribes Species

Work in this study is being concentrated upon the capacity of sticky and prickly currants to spread the disease to western white pine. One or both of these species may be sufficiently low in this regard to justify leaving uneradicated certain areas where the plants occur but sparsely. This is a possibility which may bring about a large saving in the control costs. A considerable amount of time was spent in trying to find areas in which data might be obtained on this point. It is easy to visualize the ideal area for the purpose of such a study, but to find it in nature unfortunately is quite a different proposition. However, we were able to locate two areas in which the single Ribes species was present with the pines and where infection was already established. In one area small western white pines ranging mainly 10 to 15 feet in height and mixed with few white bark pines of similar size were scattered over an area in which sticky currant of the open grown form was abundant (over 100 large plants per acre). The area is situated at an elevation of about 4000 feet on steep east-facing slope in the upper Birkenhead River watershed about 110 miles north of Vancouver. One canker dating to about 1920 or 1921 origin was found. No other pine infections were noted altho time has not yet been available for a thorough study of the area.

The other location is situated on the east bank of the Columbia River about six miles north of the main line of the Canadian Pacific Railway near Revelstoke, B. C. Here prickly currants occur scattered in a number of moist places along several small streams in the medium stand of young western white pines ranging mainly between 10 and 20 feet in height. Only two cankers were found here, both on 1921 growth and probably of 1922 origin. The latter year was an exceptionally favorable one for the infection of pines in this section. There are probably some fifty or more prickly currant bushes to the acre in this area, ranging in size from two or three to over 25 feet of live stem. A more intensive investigation of conditions there is necessary.

A systematic survey of these areas is planned for 1928 and the progress of the disease there will be followed yearly. Other localities have been found near Proctor, B. C., and between Kaslo and Nakusp, B. C., in which it is hoped additional data may be obtained upon the pine-infecting capacity of these two species of Ribes.

Damage to Western White Pine.

The three permanent damage study plots at Daisy Lake described in previous years before this Conference were reexamined this year. The main source of infection here was a heavy growth of stink and prickly currants on and about the first plot. The disease got in evidently about 1913 and by 1925 had made virtually a clean sweep of the 178 small pines ranging mainly from 15 to 20 feet in height on this plot. This year only four remained alive. These four have demonstrated some resistance but it is estimated that they also will succumb before long.

On the second plot which borders on the heavy Ribes growth there were 642 trees with a considerable number in the larger size classes ranging to 20 inches D.B.H. and 95 feet in height. Last year 99 per cent were infected with 19 per cent ranging from 2 to 41 feet in height were killed by the rust. This year 25 per cent with a height range increased to from 2 to 50 feet are dead.

On the third plot which is situated some three hundred yards from the heavy stink currant growth there has been very little change. The trees here are of about the same size as on the first plot. Seventy-seven per cent were infected last year. This year 77.3 per cent are infected and 5 small trees of the 190 have been killed.

Infection and Damage in Trees of the Larger Size Classes.

Western white pines of the larger size classes and ranging up to overmature veterans of more than 27 inches D.B.H. and 170 feet in height were climbed and systematically examined for infection on two plots totalling 7.4 acres at Daisy Lake and one plot covering 4.9 acres near Cheekye, B.C. The two plots at Daisy Lake are contiguous, certain additional data being taken on one of them. For the purposes of this report they are considered as one area. The main source of infection within 300 yards is a dense growth of prickly currant mixed with some coast black gooseberry in a moist strip some 15 yards wide extending away from one edge of the area. The area contains 460 trees of which

160 are over 100 feet in height. Of these 160 largest trees, 155 are infected, and 79, or about 50 per cent have branch cankers that will enter the stem. The lowest point at which infection will enter the bole for each of these trees ranges from 5 to 60 feet down from the top, and in 60 per cent of these cases it is below 25 feet. It is estimated that for this infection below 25 feet it will require from about 15 to 25 years for the rust to reach the stem thru the branch and girdle the bole. Thus on the basis of present infection alone, killing or heavy damage seems inevitable for at least a third of these 160 largest trees 15 to 30 years hence, and intensification of the disease will unquestionably increase this per cent and hasten damage after this time. The rust got into this locality about 1913.

Results on the Cheekye plot are similar to those at Daisy Lake. The infection here evidently spread to the trees largely from Ribes over a half-mile away, the abundance and susceptibility of the latter accounting for the exceptional distance of spread in this case.

Susceptibility of Sugar Pine and Other Species of White Pine

Seedlings of eleven species of white pines are being grown for test against the rust in British Columbia. The object is to obtain data on their susceptibility for use in silviculture. The bulk of the work in this study, however, is being concentrated upon the question of the degree of susceptibility in sugar pine. Plants of this species were exposed to infection last year and again this year at Daisy Lake. It is too early for results in this study, since the incipient cankers usually do not become apparent until the second season following exposure.

Plans for 1928

It may now be said that the basis for conclusion in the general study of the spread and development of the disease is approaching adequacy along a number of lines. The same is true in part for the study of Ribes susceptibility and some phases of the study of damage to western white pine. Time will thus be released for the handling of the increasing demands in other studies. It is planned to utilize most of this in the studies of susceptibility of sugar pine and associated Ribes, relative susceptibility of white pine species, and pine infecting power of the important Ribes associates of the white pines. It has been impossible to obtain data earlier in the first two because of earlier lack of funds for importation of sugar pine Ribes stock in sufficient quantity for an adequate test and because it has been necessary to grow the plants of the various species of white pine from seed, suitable seedling stock being unavailable at the time the study was started. The question of pine infecting power of important Ribes has had to wait the development of suitable opportunities for study. These have come with the development and spread of the disease, and even now the opportunities are not numerous. The indications given in the discussion of this question in this report under the heading "Pine Infecting Power of Ribes" are just a beginning. All of these studies will require a number of years and this demand will increase rapidly as they develop. From now on, therefore, the work will be concentrated as rapidly as possible in this direction.

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Mr. Lachmund then discussed informally, the results of work so far carried on in sample plots. On two plots in the Daisy Lake area containing 460 trees, 160 of which were over 100 ft. in height, 50% of the trees had stem cankers which would enter the bole. These cankers were situated at a distance from the top of the trees of from one to sixty feet. His estimate was that it would take eight years for the infection to get into the bole and then from twelve to fifteen years to kill the tree. In answer to a question as to old timber, Mr. Lachmund made the statement that from all they knew now, that it would be thirty-five years from the time of infection before these large trees would be killed. In plot #2 on the same area all trees of young standard size had stem cankers from one to thirty feet from the top and his estimate was that in five years the tops would begin to die. Mr. Lachmund mentioned a case in New England where a 1919 infection was actually killing trees this year.

Mr. Detwiler then presented the following paper covering the general activities of the Office of Blister Rust Control.

PROBLEMS IN THE DEVELOPMENT OF BLISTER RUST CONTROL.

by

S. B. Detwiler.

In 1923, the Ten-year Program was developed and adopted by this Conference. This program was gotten under way in 1924, and development of blister rust control in the West has gone forward in accordance with the plan and schedule laid down in the program. In fact, with respect to the development of methods of eradicating Ribes by hand and chemicals, the advancement anticipated in the program has been exceeded considerably at this time.

The spread of the rust into the Inland Empire white pine region is in accordance with the assumption on which the program was based, viz; that the rust would appear in Idaho by or before 1928. The southward spread of the rust toward the sugar pine forests has been more rapid than was provided for in the original program, and a hurried amendment of the program was made by this Conference in February 1926. The result of this amendment has been to split up the program into two parts, one providing for the progressive expansion of activities as developments under the program take place, and the other a fixed amount to take care of the sugar pine menace. It would be simpler and more understandable if this Conference would now combine these two parts into one comprehensive whole.

The Ten-year Program is divided into a period of large scale experimental control development ending with the field season of 1929, followed by a five-year period of practical control application. The estimate of $300,000 annual Federal appropriation for the fiscal years of 1931 to 1935, inclusive, was tentative because it was assumed that another conference in the winter of 1929-1930 would be required to work out an adequate schedule of accomplishment, based on developments under the first half of the program. The time for collecting all the data required for outlining the second half of the program is getting short, in view of the magnitude of the task.

It is suggested that this Conference consider the Ten-year Program very carefully in order that essential data may not be lacking when the need for it is urgent. It must be borne in mind, that application of control on an adequate scale is a matter of magnitude, and lack of vision, foresight and knowledge of economics involved can only result in an unbalanced and inadequate plan.

White pine blister rust is just gaining a foothold in the Inland Empire. It has resulted in no known damage in this region as yet. For the next five to ten years, I expect the spread of the rust to seem feeble, aside from spot infections here and there in young pine. The rust is an insidious disease and breeds a feeling of false security until after the damage has been done. I believe this fact is realized here in the West, and that control application will be done on a large scale in advance of the spread of the rust, as contemplated in the Ten-year Program. To consider that small-scale, semi-experimental control work is all that is required until the disease actually becomes established in the region means defeat, because our present control momentum will have been lost. The Ten-year Program plans for an offensive rather than a defensive fight, and this is required with an enemy as aggressive as the rust is proving to be.

This Conference must bear in mind that the western white pine is far more susceptible to infection by the rust than is eastern white pine, and that the Ribes are more numerous in the western forests. The same is probably true of sugar pine. From limited field observations in Vancouver, B. C., and on the Olympic Peninsula, I estimate that Pinus monticola is at least five times as susceptible as Pinus strobus, and the correct figure may be more. This is based on a comparison of the number of cankers occurring on trees of the two species, growing side by side of the same age, size and vigor, and subject to the same conditions of infection. Judging by the damage done to eastern white pine by the rust during the past twenty years, it is the part of wisdom to start off with a vigorous policy in applying control ahead of the spread of the rust, as contemplated in the Ten-year Program of this Conference.

It is important that the best pine sites be given protection first. Based upon lumbering and management experiences a certain percentage of the white pine area is so clearly site one that there is no doubt about continuing it in white pine. Control costs are sufficiently low to make this practicable. Closer figuring is necessary where the pine values are lower. It, therefore, appears essential that we get started on the best pine lands and develop as rapidly as possible a reliable basis for considering protection work for the less valuable pine areas.

The fundamental facts on which the scope and scale of the control application should be based are being obtained by control reconnaissance from field surveys and all available sources. This work will be finished for the Inland Empire region by the fall of 1929, but our activities must be increased if this work is to be completed in the sugar-pine region by that time. But even with all the data we can supply

through control reconnaissance, it will be impossible to formulate a proper program for application of control without certain additional facts from other sources. These additional facts are required to interpret the control reconnaissance data; and are as follows:

1. A study by the forest experiment stations of the economics of the situation with respect to western white and sugar pine, to determine growth and yield of these species in normal stands in the various types and ages, estimate probable future stumpage values, and furnish a basis to determine what control costs are feasible under different type, site, accessibility conditions and varying percentages of pine in mixture at varying ages and densities. This study has long been urged. It will furnish the basis for judging the advisability of continuing white pine on the poorer sites. The whole matter of cooperation by the forest experiment stations in helping to work out a permanent blister rust control policy is one to which this Conference should give careful attention. The forest experiment stations are best qualified to furnish a fair and reliable basis for estimating present and future values that are threatened.

2. Cooperation with those in charge of the white pine lands is necessary to actually choose those areas and sites on which control work should be done first, and to determine how far it is financially profitable to extend control. No difficulty is expected in this matter if proper data is available on which to base practical decisions. It would be in the interests of the private timber owners to devise some way by which our reconnaissance forces can use their estimates of merchantable pine. If this information has been made available to any other Federal agency, such as the Forest Service, in a form which will safeguard the interests of the companies concerned, there should be no difficulty in adopting it to our use. I realize that this is a matter of some delicacy, but there is undoubtedly a way by which the essential data may be had without detriment to the timber owners.

3. An effort should be made to determine an equitable basis for expenditure of federal, state and private funds in control work. It seems obvious that the responsibility for protecting present actual merchantable values rests with the owner of the timber. This does not appear to me to be so obvious in the case of immature timber. To what extent can we look to the private timber owner to protect immature pine which at present has little cash value or even a minus value? Protection of the future pine stands appears to me to be a joint federal and state responsibility. Of course land actually held by the Federal Government or by the State should be protected at the expense of the government or the state, as owned.

We need light on those steps which should be taken between now and 1930 to get actual control operations into full swing with the least waste of funds and energy. I look on the next two field seasons as a transition period from the experimental to the practical. The work would be practical in accomplishment, but experimental as to the organization of practical control units. For example, the Priest Lake Timber Protective Association has already asked that a small control unit be started on their lands next season, on a fifty-fifty basis of cost. It would be very helpful to arrange similar cooperation with the Clearwater Timber Protective Association; with the Mountaineers' Club (Bremerton, Washington) and the Long Bell Timber Company on their nursery and planting sites in southwest Washington. It is felt that as a matter of public policy, the government forest nurseries at Wind River, Washington, and Haugan, Montana, should be protected with our funds. Possibly also some experimental white pine plantations made by the Forest Service on the Olympic Peninsula, and already beginning to be infected also should be protected with our funds. We are greatly in need of small experimental control areas to determine the actual protection afforded by standard Ribes eradication work under various site and topographic conditions. Such experiments can safely be laid out in the Olympic Peninsula where the rust is now strongly established. All of this work would have a high experimental value in addition to the actual protection of pine values. Ribes eradication work has reached a stage where it is safe to undertake such work so far as funds permit, if this Conference deems it advisable.

In conclusion, this Conference should consider the matter of personnel. We have developed as many leaders of eradication work as our funds have permitted. These men have had to start as crew men and have advanced as their abilities warranted. This policy has resulted in securing dependable and efficient men. However, the control work is seasonal, and we have felt warranted in carrying through the winter only a few new men each year. The result is that men to head new eradication units are scarce. This Conference should consider this matter in the light of future needs, and work out some plan whereby a sufficient number of leaders will be available hereafter as needed. Without well-trained capable and trustworthy leaders, large scale control work is apt to bog down of its own weight. Ribes eradication work must be held down to the lowest possible costs but not at the expense of effective control results.

* * *

Mr. Detwiler emphasized the significance of several developments and discoveries:

First: That the development of control methods were now ahead of schedule.

Second: That developments in chemical eradication have been carried on to a point wherein one species could be absolutely killed by this method. Mr, Detwiler stated that if one species could be killed, there was every reason to believe that the others could and that he believed that chemical eradication would be developed to a point where this would be possible.

Third: Another outstanding development is the ease with which Ribes can be discouraged. The seeds fall near the plants on which they are grown and while it is certain that they lie dormant for a long time, it is almost as certain that when favorable conditions obtain, all will germinate at once. This means that areas can be kept free of Ribes much easier than would be the case if there was a wide seed dissemination.

Mr. Detwiler further stated that the most urgent need now was for a working map showing the areas in north Idaho where control work will pay so that interested owners, federal, state and private, could construct their programs for eradication and take this into consideration in their management plans. Mr. Detwiler stated that in the East where white pine blister rust has been established for some time, private owners were now carrying on eradication work on from 800,000 to 1,000,000 acres annually.

AFTERNOON SESSION

The meeting reconvened at 1:30 P. M.

Dr. Metcalf from the Office of Forest Pathology, was asked to tell the Conference about a new disease known as the European Larch Canker which has been found in the East, and he gave the following very interesting discussion of this new disease:

"A canker disease seriously attacking planted Douglas fir and western yellow pine has turned up in Massachusetts. It also attacks European larch, the native eastern tamarack (Larix laricina), and to a less extent Japanese larch and Scotch pine. It is believed to be the European Larch Canker, a well-known disease of this species in Europe. There is a clear record of importation of nursery stock of European larch into the plantations now infected.

"The eastern tamarack has an unbroken distribution across Canada, and could readily carry the disease from Massachusetts to the Douglas fir, western larch, and western yellow pine of the Rocky Mountains and Pacific Coast. Herein lies the danger to the interests represented at this meeting. At present the disease has been found only in an area about 14 miles long by 4 miles wide. If it proves to be really limited to this area it might yet be eradicated. It attacks no eastern tree except the unimportant tamarack. Hence we have the unusual spectacle of a disease appearing on the Atlantic Coast which is a potential menace only to the Far West."

The next order of business was a general discussion of the white pine blister rust situation. Mr. Mason asked what should be done for instance with a 200-year old stand of white pine in Idaho, all of which would be cut in 20 years. Should this area be protected or could the timber be removed before the disease had done any damage. A general discussion brought out the belief that old mature timber in Idaho was comparatively safe for at least 20 years but that no general rules of eradication could be laid down. Only by a pre-eradication survey could it be determined

what treatment any tract or group of tracts should receive. Mr. Mason asked if there was any chance of partial control by developing a denser shade through better forest management, and the discussion brought out the belief that partial control could be obtained by developing denser shade.

The following recommendations were unanimously adopted:

RECOMMENDATIONS OF CONFERENCE

1. That all possible effort be made through our congressional delegations and otherwise to see that a Federal Appropriation of $260,000, the same amount appropriated for the fiscal year 1928 be made available for the year 1929.

2. That the Federal Forest Service be urged to undertake such studies in the white and sugar pine regions as will tend to show conditions under which these species may profitably be grown.

3. That the revised ten year program requires no material change at this time and should be followed through in the interest of protection of western white and sugar pine.

4. That upon application and with proper arrangements as to cost of the work, the Office of Blister Rust Control provide central plans for timber land owners desirous of determining feasability of Ribes eradication on their holdings.

5. That our various states continue and increase their efforts looking to control of white pine blister rust.

6. That quarantine regulations be continued and strengthened and enforced as conditions warrant.

In addition, the following resolution proposed by Mr. Cowan, was adopted:

That whereas, the White Pine Blister Rust Conference is deeply interested not only in white pine blister rust but in any disease which threatens any of our merchantable species and especially in one that there is possibility of stamping out in its incipiency, that it is the sense of this meeting that the work of Dr. Metcalf is greatly appreciated and the Conference asks to be kept informed as to any new data which is gathered concerning the so-called European Larch Canker.

The meeting adjourned at 3:45 P.M.

Finis

ATTENDANCE

C. L. Billings	Clearwater Timber Company	Lewiston, Idaho.
J. S. Boyce	Office Forest Pathology	Portland, Oregon.
Ben E. Bush	State Forester	Moscow, Idaho.
R. H. Chapler	Western Forestry & Conservation Association	Portland, Oregon.
C. S. Chapman	Weyerhaeuser Timber Company	Tacoma, Washington.
C. S. Cowan	Washington Forest Fire Association	Seattle, Washington.
S. B. Detwiler	Office of Blister Rust Control	Washington, D. C.
J. W. Ferguson	Clackamas-Marion Fire Patrol Association	Malalla, Oregon.
Dr. E. E. Hubert	University of Idaho	Moscow, Idaho.
W. D. Humiston	Potlatch Lumber Company	Potlatch, Idaho.
Geo. C. Joy	State Supervisor of Forestry	Olympia, Washington.
Elers Koch	Forest Service	Missoula, Montana.
H. G. Lachmund	Office of Forest Pathology	Portland, Oregon.
D. T. Mason	Mason & Stevens	Portland, Oregon.
E. H. McDaniels	Forest Service	Portland, Oregon.
H. F. Meier	Pacific Northwest Forest Experiment Station	Portland, Oregon.
Dr. Haven Metcalf	Office of Forest Pathology	Washington, D. C.
T. T. Munger	Pacific Northwest Forest Experiment Station	Portland, Oregon.
C. L. Park	State Horticultural Association	Salem, Oregon.
G. B. Posey	Office of Blister Rust Control	Washington, D. C.
W. F. Ramsdell	Forest Service	Portland, Oregon.
C. C. Scott	Fire Patrol Association	Portland, Oregon.
Jack Vernon	Lenn County Fire Patrol Association	Lebanon, Oregon.
J. P. Weyerhaeuser	Weyerhaeuser Timber Company	Tacoma, Washington.
J. B. Woods	Long Bell Lumber Company	Longview, Washington.
S. N. Wyckoff	Office of Blister Rust Control	Spokane, Washington.

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BLISTER RUST WORK
IN THE FAR WEST

January 1 to December 31, 1927.

Spokane Branch
Office of Blister Rust Control
618 Realty Building
Spokane, Washington

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BLISTER RUST WORK IN THE FAR WEST

January 1 to December 31, 1927.

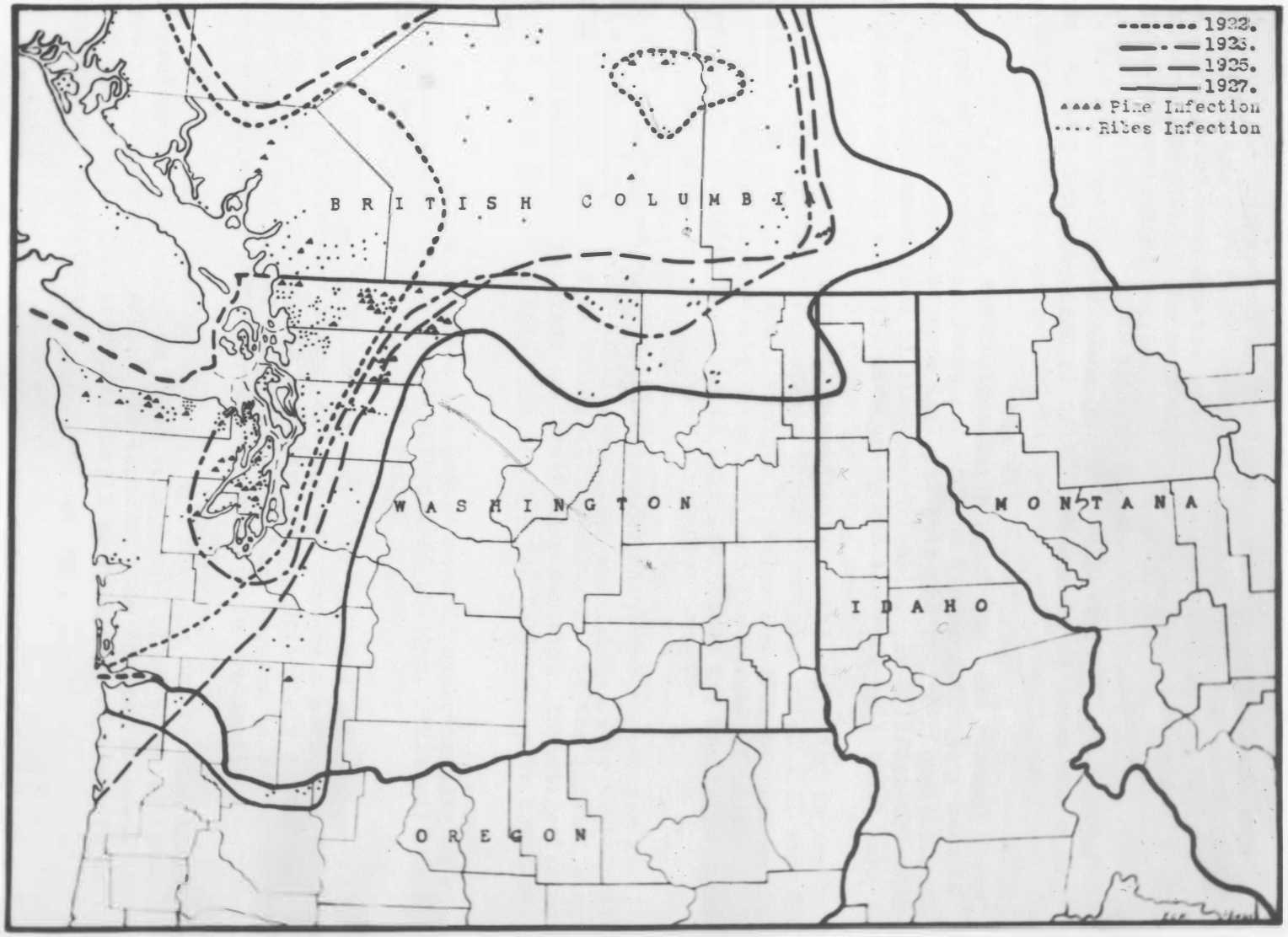
* * *

INTRODUCTION

The following report is designed to summarize the activities of the Western Branch of the Office of Blister Rust Control, Bureau of Plant Industry, for the calendar year 1927.

The most important development of 1927 has been the spread of the rust into north Idaho and northwestern Oregon. A moist spring and summer, occurring at a time when the centers of pine infection in western Washington and eastern British Columbia were sufficiently developed to provide the requisite number of aecia, resulted in one of the more or less periodic southward thrusts of the disease. The result of this southward spread is that at least two counties in the northern end of Idaho and five counties in northwestern Oregon must be regarded as potentially infected with blister rust. The following map will show the rate of spread of the rust during the period of 1922 to 1927.

SPREAD OF WHITE PINE BLISTER RUST IN THE WEST



As this spread of the disease was not known until near the end of the 1927 field season, it did not cause any alteration in the plan of work for the year, which proceeded on the basis of the original plans. The most important results of the season's work may be summarized as follows:

1. Cultivated black currant eradication: completion of program with the exception of California, where at least two more seasons of work are necessary.

2. Control reconnaissance: a point has been reached where the end of this work in Idaho and Montana can be definitely seen. One more full season of work will put this project on a basis whereby it could be discontinued if thought advisable. In California, reconnaissance methods are well developed, and the work well under way.

3. Experimental Ribes eradication: the unit used in north Idaho in 1927 probably represents the maximum size which will ever be necessary in a single locality. The organization side of such an operation is now fairly well developed, and the number of units possible to put into the field is only limited by the available supervisory personnel.

4. Experimental chemical eradication: sprays are now available of known efficiency in killing Ribes petiolare. Crew organization with knapsack sprayers is fairly well developed, and the initial stage of experimentation in power equipment is under way. Investigative work on chemicals to kill Grossularia inermis and R. lacustre is now thoroly organized.

5. Methods studies: the ground work of experimenting on Ribes eradication organization is now well out of the way. This will permit more intensive experimentation on actual methods.

6. Studies in Ribes ecology: this work has now passed thru a necessary preliminary stage, and has now reached a period of development wherein the problems to be solved can be definitely stated and worked upon. Sufficient information has been secured to serve as at least a preliminary basis for methods studies in eradication.

7. Pine infection studies: the rust has now reached a stage of development in Washington which will permit close study of local areas to determine the effect, in terms of pine damage, of known amounts of Ribes leafage. The information will be of direct application to local control operations.

The activities of the Western Branch of the Office of Blister Rust Control were, for the period January 1, 1927 to June 30, 1927, conducted from the funds of $160,000 allotted to western work for the fiscal year 1927. For the period July 1, 1927 to December 31, 1927, this work was carried on from the funds of $260,000 allotted to western work for the fiscal year 1928. The funds indicated were officially allotted to the various phases of the western control program as follows:

Allotment of Funds, Fiscal Year 1927.

Project	Period July 1, 1926 to June 30, 1927.
A. Study and Application Delay Measures	
1. Continuance toward eventual completion of eradication of cultivated black currants in the states of Montana, Idaho, Washington, Oregon and California. (Preliminary control measures.)	$15,000
2. Continuance of necessary quarantine inspection to prevent further dissemination of the rust through shipment of infected host plants	9,500
3. Field inspections and surveys in Oregon to determine the spread of the disease from year to year and to apply practical measures of checking it.	10,000
B. Study of Disease to Determine Important facts Influencing its Control	
1. Pathological investigation	12,000
C. Experimental Development and Application of Local Control Measures	
1. Control reconnaissance to determine the potential blister rust danger in various localities and forest stand types and to estimate cost of control	
(a) In western white pine region	10,000
(b) In sugar pine region	5,000

Project (Cont'd.)	Period July 1, 1926 to June 30, 1927 (Cont'd)
2. Large scale demonstration in the application of local control on the national forests in the western white pine belt	$44,500
3. Cooperative demonstration of local control on State and private western white pine lands	10,000
4. Small scale demonstrations in the application of local control on the national forests in the sugar pine belt	10,000
5. Development of improved control methods, reduction of eradication costs, and working out methods for assuring efficiency of eradication on control areas, including a study of Ribes regrowth on 1922 and 1923 control areas	
(a) In western white pine areas	10,000
(b) Sugar pine areas	4,000
6. Experiments to determine the toxicity of chemicals and to develop effective means of applying them in Ribes eradication	5,000
7. Study of Ribes ecology to determine factors influencing occurrence and regrowth of these plants in western white and sugar pine forests	5,000
D. Educational activities to inform the public concerning blister rust and to secure its cooperation in applying measures for the control of this disease	10,000
Total.	$160,000

Allotment of Funds, Fiscal Year 1928.

Project	Period July 1, 1927, to June 30, 1928.
A. Delaying spread of blister rust	
1. Eradication of cultivated black currants in Idaho, Washington and California	$16,071.67
2. Quarantine inspection (West only)	9,350.00
3. Field surveys and inspection of nurseries in Oregon	4,335.00
4. Field surveys in northwestern states to determine location of dangerous centers of pine infection and to follow the natural advance and establishment of blister rust in the northern area	14,473.33
B. Development and application of local control	
1. National forests of northeastern Washington, Idaho and northwestern Montana	53,215.00
2. Local control on state and private land dollar for dollar cooperation between Federal Government and timber owners	11,055.00
3. Control reconnaissance in Idaho, Montana and northeastern Washington	14,766.67
4. Studies of local control and its costs in California	13,310.00
5. Control reconnaissance and Ribes survey, California sugar pine areas	7,000.00
6. Studies of local control and recheck of 1925 eradication area, Oregon	6,095.00
C. Investigational work, Office of Forest Pathology	21,500.00
D. Experimental work on chemical eradication and studies on Ribes ecology	24,065.00
E. Educational work	6,313.33
F. Field supervision, maintenance of Spokane office, miscellaneous supplies	19,950.00
G. Mississippi Valley quarantine work, maintenance of Washington office, Departmental reserves	38,500.00
Total	$260,000.00

It will be noted that included in this allotment of funds are two items, "C" and "G" which, while directly effecting the western control program, are not expended by the Western Office of Blister Rust Control. Notwithstanding this fact, each is individually necessary to the progress and direction of the field work or administration general activities.

Item "G" is made up as follows:

2% Departmental Reserve	$ 5,200
1% Bureau Reserve	2,600
Maintaining of head office, western charge	10,000
Mississippi Valley Quarantine	20,700
Total	$38,500

The present organization of the Western Branch of the Office of Blister Rust Control is yet in a transitional stage between close centralization, in which the work is all organized under direct supervision of the Spokane Office. The majority of the project leaders are permanently headquartered at Spokane. The state leaders for Montana, Oregon and California are headquartered in those states as well as certain project leaders due to facilities and conditions which make it possible to carry on certain work the full year. Even though more and more work is organized locally in the various states, the general supervision to which the state leaders are responsible will remain with the Western Branch Office at Spokane, Washington.

The following is the permanent western personnel which was employed during the period covered by this report:

1. Supervisory: S. N. Wyckoff, Pathologist, In Charge of Western Branch Office.

2. Project Leaders:

(a) Quarantine Inspection - C. R. Stillinger, Associate Pathologist.

(b) Ribes Ecological Studies - W. A. Rockie, Assistant Pathologist.

(c) Control Reconnaissance on Federal and Private Lands, Idaho and Washington - J. L. Bedwell, Assistant Pathologist, assisted by M. C. Riley, Junior Forester; W. F. Painter, Agent; and H. F. Geil, H. L. Whiting, G. M. Whiting and R. E. Myers, Collaborators.

(d) Experimental Ribes Eradication, Idaho - C. C. Strong, Assistant Forester, assisted by F. A. Patty, Junior Pathologist; B. A. Anderson and P. S. Simcoe, Junior Foresters and A. H. Glasgow, D. R. Payne, H. E. Swanson, and C. O. Peterson, Agents.

(e) Educational Work - C. R. Stillinger, Associate Pathologist.

(f) Studies on Spread of the Rust and Damage to Pine- H. N. Putnam, Associate Pathologist, assisted by E. L. Joy, Junior Forester and R. L. MacLeod, Agent.

(g) Experimental Chemical Eradication - H. R. Offord and P. B. Bell, Agents.

(h) Cultivated Black Currant Eradication, Washington - G. A. Felch and B. A. Ganoung, Agents.

3. State Leaders:

Montana, C. H. Johnson, Assistant Pathologist.
Oregon, L. N. Goodding, Associate Pathologist.
California, G. A. Root, Assistant Pathologist, assisted by Project Leaders, W. V. Benedict, Junior Forester- (Eradication), E. C. Kenyon, Agent - (Reconnaissance.)

4. Clerical Work:

R. Calhoun, Principal Clerk and Temporary Special Disbursing Agent.

Miss M. L. McWold, Clerk.

Mrs. L. Klatt, Asst. Clerk-Stenographer.

Miss S. K. Millick, Under Clerk-Typist.

Miss A. M. Fellows, Under Clerk-Typist.

BLISTER RUST CONTROL WORK IN MONTANA
1927

The following is the memorandum of understanding under the terms of which the work in Montana is organized:

MEMORANDUM OF UNDERSTANDING
between
THE BUREAU OF PLANT INDUSTRY, U. S. DEPARTMENT OF AGRICULTURE
and the
MONTANA STATE DEPARTMENT OF AGRICULTURE - - - MONTANA STATE FORESTRY DEPARTMENT - - - SCHOOL OF FORESTRY, UNIVERSITY OF MONTANA - - - and NORTHERN MONTANA FORESTRY ASSOCIATION
relative to
Cooperative White Pine Blister Rust Control Work in Montana
Effective July 1, 1927.

--------oOo--------

A. The BUREAU OF PLANT INDUSTRY agrees to:

(1) Pay the salaries and necessary travel expenses of one or more employees who shall conduct such work;

(2) Assist in systematically locating and destroying cultivated black currants (Ribes nigrum) under state authority;

(3) Inspect plant shipments to supplement blister rust quarantines;

(4) Conduct experiments in control reconnaissance and local Ribes eradication, demonstrate the practical application of control practices, and obtain data on the spread of the rust; and

(5) Coordinate control activities of the several cooperating states and agencies by furnishing regional leadership and supervision, and to provide employees and the cooperating agencies with blister rust subject matter and technical information.

B. The MONTANA DEPARTMENT OF AGRICULTURE agrees to:

(1) Pay the salaries and expenses and direct the work of one or more men who shall, during the proper season, inspect plant shipments for violation of blister rust quarantines;

(2) Use its regular employees, so far as their other duties permit, and direct their work in systematically locating and destroying cultivated black currants, scouting for white pine blister rust and inspecting nurseries for this disease;

(3) Undertake such destruction of white pine or Ribes in Montana and such enforcement of state laws as may be necessary for the effective prosecution of blister rust control work; and

(4) Furnish the State Leader in charge of blister rust control work in Montana such office space as is necessary for properly conducting his work.

C. The MONTANA FORESTRY DEPARTMENT agrees to:

(1) Use its regular employees, so far as their other duties permit, in systematically locating and eradicating cultivated black currants, scouting for white pine blister rust and taking such action as may be necessary to delay the spread of blister rust into white pine areas under its control and supervision.

D. The SCHOOL OF FORESTRY, UNIVERSITY OF MONTANA, agrees to:

(1) Assist the cooperating agencies so far as practicable in carrying out the activities enumerated in this memorandum.

E. The NORTHERN MONTANA FORESTRY ASSOCIATION agrees to:

(1) Use its regular employees, so far as their other duties permit, in systematically locating and eradicating black currants, scouting for white pine blister rust and taking such action as may be necessary to delay the spread of blister rust into white pine areas under its control and supervision.

F. IT IS MUTUALLY AGREED that:

(1) This memorandum may be terminated by either party by written notice, and may be amended by written mutual agreement;

(2) The cooperative plan of work in this memorandum will be followed as being the best method of control of white pine blister rust in Montana;

(3) All official records and reports of work performed under this agreement shall be open to inspection by any or all parties to this agreement, that all findings of blister rust made by any party to this agreement shall be promptly reported to all other parties to this agreement, and that all specimens collected by any party to this agreement which are suspected of being infected with blister rust shall be submitted promptly to the Bureau of Plant Industry for final determination;

(4) The results of the cooperative work may be published jointly, or upon mutual agreement by either cooperating party, due credit being given to the cooperating agencies. All manuscripts therefor shall be criticised by the cooperating parties before publication; and all form letters, bulletins and any other circulars to be mailed in penalty envelopes shall be submitted in manuscript form for approval by the Bureau of Plant Industry before being printed or distributed;

(5) Obligations by the Bureau of Plant Industry are contingent upon appropriations being made therefor by Congress; and no funds of the United States shall be expended in compensation for host plants destroyed in control work;

(6) For the Fiscal Year 1928, the Bureau of Plant Industry shall contribute in value approximately $6,000, the Montana State Department of agriculture approximately $5,000, the Montana State Forestry Department

approximately $1,200, the School of Forestry, University of Montana, approximately $300, and the Northern Montana Forestry Association shall contribute in value approximately $1,000; thereafter the amount to be contributed by each shall be determined and agreed upon by supplemental correspondence.

Date:	Signature:
7/29/27	(s.) A. H. Bowman Commissioner, Montana Department of Agriculture.
8/1/27	(s.) Rutledge Parker State Forester, Montana Forestry Department.
8/1/27	(s.) Thos. C. Spaulding Dean, School of Forestry, University of Montana.
8/24/27	(s.) A. E. Boorman Secretary, Northern Montana Forestry Association.
9/19/27	(s.) W. A. Taylor Chief, Bureau of Plant Industry.

CONTROL RECONNAISSANCE ON THE KOOTENAI AND CABINET NATIONAL FORESTS

By
C. H. Johnson
Assistant Pathologist

Control reconnaissance in 1927 was performed on the Kootenai and Cabinet national forests, both areas being very similar, the topography varying from gentle slope to steep precipitous crags which generally serve as a boundary between the two forests. The principal drainage on the Kootenai are: The Kootenai and Yaak Rivers, Libby, O'Brien and Callahan creeks and tributaries to these streams. The Clarks Fork, Bull and Thompson rivers and their tributaries are the chief drainages of the Cabinet Forest.

Economic Development

Lumbering, mining and farming are the leading industries in the region. Only small areas on the Cabinet are adaptable to farming. It is safe in stating that 90 per cent of the area of both forests is best suited for growing timber and whatever prosperity and means of livlihood comes to the inhabitants of the region will, in a large measure, be derived from the forests.

Accessibility

Much of the remaining mature timber on the Kootenai Forest is very inaccessible. However, modern methods of logging will most likely solve the transportation problem. The forest is well served by trails for protective purpose.

On the Cabinet Forest only small areas of mature white pine remain, but prospects are bright for the future as there exists large areas of white pine reproduction and pole size timber which represents the next timber crop. Most of the timber is accessible either by water or railroad transportation or highways and logging roads. In general logging chances are good. The chief problem on the Cabinet is one of protection until the younger stands reach maturity.

Forest Types and Age Classes

White pine does not occur in pure stands but is found associated with larch, Douglas fir, hemlock, cedar and lodgepole and generally confined to north and east slopes, benches and levels to gentle slopes. All age classes from 1 to 200 years plus occur on both forests, but owing to its accessibility it appears that the Cabinet Forest was the scene of greater logging activities which accounts for the younger stands. The 1910 fire was also more severe on the Cabinet Forest.

Ribes Conditions

The three species of Ribes found on the Kootenai and Cabinet forests are named in order of their predominance. They are: R. lacustre, R. viscosissimum and Grossularia inermis. There is, however, a very noticeable difference in the number of Ribes occurring on similar eradication types of the two forests. On the Cabinet Forest the reproduction and pole eradication types are very short on Ribes. The number of Ribes along the streams on the Kootenai are greater in number than found along the streams on the Cabinet. This scarcity of Ribes may be partly due to the severity of the burns and the more frequent occurrence of fires which have swept over the Cabinet Forest.

TABLE NO. 1

Land Description and Areas Reconnaissanced in Montana

Forest	T.	R.	Intensive Reconn. Sections by Nos.	Sec.	Acres	Extensive Reconn. Sections by Nos.	Sec.	Acres	Total Sec.	Total Acres
	24N	34W	1,2,12,	3	1,920					
	25N	33W	19,30,31	3	1,920					
Cabinet	25N	34W	24,25,26 36	4	2,560					
	25N	32W	1,2,3,10 15,32,33 19,25,27 29,34.	12	7,680	5,6,7,8, 11,14,22 23,24, 26.	10	6,400		
National	26N	33W	9,16	2	1,280	20	1	640		
	26N	34W	35	1	640					
	27N	32W	3,4,5,8, 11,33,34	7	4,480	1,2,6,9, 10,12	6	3,840		
	28N	32W	31,32,34	3	1,920	6,7,16, 19,20,30 33,35	8	5,120		
Forest	28N	33W	29,30	2	1,280	1,12,14, 24,25	5	3,200		
	29N	32W				31,36	2	1,280		
Totals				37	23,680		32	20,480	69	44,160

TABLE NO. 2

Land Description and Areas Reconnaissanced

Forest	T.	R.	Intensive Reconn. Sections by Nos.	Intensive Reconn. Total Sec.	Intensive Reconn. Total Acres	Extensive Reconn. Sections by Nos.	Extensive Reconn. Total Sec.	Extensive Reconn. Total Acres	Total Sec.	Total Acres
	27N	30W	6,7,18, 19	4	2,560					
	27N	31W	15,1,2, 3,4,11, 12,13,14	9	5,760	21,24,8 9	4	2,560		
Kootenai	28N	31W	2,3,4,5, 9,10,13, 14,15,16 17,18,20 21,22,23 26,27,28 29,35,36	22	14,080	24,25,30 32	4	2,560		
National	29N	32W	10,11,12 16,17	5	3,200	8,9,15, 20	4	2,560		
	32N	32W	2,3,4,8 9,10,11 14,17,20 21,23,26 27,28,34 35.	17	10,880					
Forest	32N	33W	2,3,4,9, 10,11,12 13,21,22 28,29	12	7,680					
	33N	31W	4,5,6,9, 16,17,21	7	4,480					
	33N	32W	23,26,34 35.	4	2,560					
	34N	33W	5,6,7,8, 9,16,17, 19	8	5,120					
Totals				88	56,320		12	76,680	100	64,000

TABLE NO. 3

Total Number of Acres Reconnaissanced--Kootenai National Forest--1927, Classified According to Age, Classes and Eradication Types

Erad. Types	White Pine Type - Age - Classes								
	1-10	11-20	21-40	41-60	61-80	81-100	101-200	201-	Total
D.M.							3,242	680	3,922
O.M.							6,550	3,268	9,818
D.P.			1,572			80			1,652
O.P.		180	5,305		30	75			5,590
D.R.	530	700							1,230
O.R.	355	3,240							3,595
Str.		59	36			7	261	138	501
Total	885	4,179	6,913		30	162	10,053	4,086	*26,308

*In addition to this area there were 37,692 acres of type other than white pine covered by the reconnaissance. These non-white pine areas were not classified into age class or eradication types.

TABLE NO. 4

Number of Acres Intensively Reconnaissanced, Classified According to Eradication Types and Number of Ribes per Acre Classes
Kootenai National Forest

Erad. Types	Number of Ribes lacustre per Acre Classes																			
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-125	126-150	151-175	176-200	201-250	251-300	301-400	401-500	501-750	Total
D.M.	1,985	95	640	65	90	135		140			122										3,272
C.M.	475	5,060	1,851	1,440	370	40	206	40	110		28										9,620
D.P.	602	545	295								70										1,512
C.P.	610	1,170	1,730	460	270	273	105		517	125											4,990
D.R.	150	300	480										120	80							1,130
C.R.	1,337	1,065	880	178	120																3,580
Str.	14	9		11		21			25		14	35	18	33	22	53	31	98	44	36	464
Brush																					
Total	5,173	8,244	5,876	2,154	580	469	311	180	652	125	234	35	138	113	22	53	31	98	44	36	24,568

TABLE NO. 5

Number of Acres Intensively Reconnaissanced. Classified According to Eradication Types and Number of Ribes Per Acre Classes, Kootenai National Forest

Erad. Types	Number of Ribes viscosissimum Per Acre Classes													
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-125	126-150	Total
D.M.	1,985													1,985
O.M.	475													475
D.M.	602													602
O.P.	610													610
D.R.	150	40	40									50		280
O.R.	1,337	310												1,647
Str.	14												5	19
Brush														
Total	5,173	350	40									50	5	5,618

TABLE NO. 6

Number of Acres Intensively Reconnaissanced Classified According to Eradication Types and Number of Ribes Per Acre Classes
Kootenai National Forest

Erad. Type	Number of all Ribes per Acre Classes																				
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-125	126-150	151-175	176-200	201-250	251-300	301-400	401-500	501-750	Total
D.M.	1,985	95	640	65	90	135		140			122										3,272
C.M.	475	5,060	1,851	1,440	370	40	206	40	110		28										9,620
D.P.	602	545	295								70										1,512
C.P.	610	1,170	1,730	460		273	105		517	125											4,990
D.R.	150	210	480									50	130	80							1,090
C.R.	1,337	1,065	880	178	120																3,580
Str.	14	9		11	31	21			25		14	35	23	33	22	53	31	98	44	36	469
Brush																					
Total	5,173	8,154	5,876	2,154	580	469	311	180	652	125	234	85	143	113	22	53	31	98	44	36	24,533

TABLE NO. 7

Distribution of Ribes by Species
Kootenai National Forest

Ribes Species	Per Cent of Total Acres Reconnaissanced Which Has		
	No. Ribes Per Acre	1 to 10 Ribes Per Acre	More Than 10 Ribes Per Acre
R. lacustre	21.1%	33.5	45.4
R. visco.	92.1	6.2	1.7
All Ribes	21.1	33.2	45.7

TABLE NO. 8

Number of Ribes Per Acre By Ribes Species and Eradication Types
Kootenai National Forest

Erad. Types	Number of Ribes By Species Per Acre			
	Acres Reconn.	R. lacustre	R. visco.	All Ribes
D.M.	3,272	16.9		16.9
O.M.	9,620	17		17
D.P.	1,512	16.3		16.3
O.P.	4,990	18.1		18.1
D.R.	1,090	49.7	17.5	67.2
O.R.	3,580	8.2	.9595	9.1
Stream	469	216.2	2	218.2
Brush				
Totals & Averages	24,533	21.1	.913	22

TABLE NO. 9

Total Numbers of Acres Reconnaissanced, Cabinet National Forest - 1927 Classified According to Age, Classes and Eradication Types

Eradication Types	White Pine Types - Age - Classes									Non-white Pine Types - Age - Classes									
	1-10	11-20	21-40	41-60	61-80	81-100	101-200	201+	Total	1-10	11-20	21-40	41-60	61-80	81-100	101-200	200+	Not Classified	Total
D.M.							1,230	890	2,120							489		2,218	2,707
C.M.							180	4,533	4,713							456	280	2,696	3,432
D.P.			3,875	1,600					5,475									7,798	7,798
C.P.			1,725	380	220				2,323			1,565						6,402	7,967
D.R.		1,230						1,230	1,230									3,618	3,618
C.R.		1,110						1,110	1,110									1,319	1,319
Stream		69	81	37	4		44	113	348										
Brush																			
Clearing																			
Not Classified																			
Totals		2,409	5,679	2,017	224		1,454	5,536	17,319			1,565				945	280	24,051	26,841

TABLE NO. 10

Number of Acres Intensively Reconnaissanced, Classified According to Eradication Types and Number of Ribes Per Acre Classes, Cabinet National Forest

Erad. Type	Number of Ribes lacustre Per Acre Classes																	
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-125	126-150	151-175	176-200	201-250	251-300	301-400	Total
D.M	890	1,130																	2,020
O.M.	1,638	2,135																	3,773
D.P.	2,015	180																	2,195
O.P.	743	170																	913
D.R.	350	230																	580
O.R.																			
Str.	6			9	13	11			9		6	33	21	41	5	25	12	22	213
Total	5,642	3,845		9	13	11			9		6	33	21	41	5	25	12	22	9,694

TABLE NO. 11

Number of Acres Intensively Reconnaissanced Classified According to Eradication Types and Number of Ribes Per Acre Classes Cabinet National Forest

Erad. Type	Number of Grossularia inermis Per Acres Classes. 0	1-10	11-20	21-30	31-40	41-50	Total
D.M.	890						890
O.M.	1,638						1,638
D.P.	2,015						2,015
O.P.	743						743
D.R.	350						350
O.R.							
Stream	6				4		10
Total	5,642				4		5,646

TABLE NO. 12

Number of Acres Intensively Re-Connaissanced Classified Accord ing to Eradication Types and Number of Ribes Per Acre Classes Cabinet National Forest

Erad. Type	Number of Ribes viscosissimum Per Acre Classes 0	1-10	11-20	Total
D.M.	890			890
O.M.	1,638			1,638
D.P.	2,015	710		2,725
O.P.	743			743
D.R.	350			350
O.R.		490		490
Stream	6	14	6	26
Total	5,642	1,214	6	6,862

TABLE NO. 13

Number of Acres Intensively Reconnaissanced Classified According to Eradication Types and Number of Ribes Classes, Cabinet National Forest

Erad. Type	Number of all Ribes per Acre Classes																		
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-125	126-150	151-175	176-200	201-250	251-300	301-400	Total
D.M.	890	1,130																	2,020
O.M.	1,638	2,135																	3,773
D.P.	2,015	890																	2,905
O.P.	743	170																	913
D.R.	350	230																	580
O.R.		490																	490
Str.	6	14	6	9	17	11	11		9		6	35	25	41	5	25	12	22	243
Total	5,642	5,059	6	9	17	11			9		6	35	25	41	5	25	12	22	10,924

Table No. 14

Distribution of Ribes by Species
Cabinet National Forest

Ribes Species	Per Cent of Total Acres Reconnaissanced Which Has		
	No Ribes per Acre	1 to 10 Ribes per Acre	More than 10 Ribes Per Acre
R. lacustre	58.2%	39.7%	2.1%
G. inermis	99.92%		.08%
R. visco.	82.2%	17.7%	.1%
All Ribes	51.7%	46.3%	2%

Table No. 15

Number of Ribes per Acre by Ribes Species and
Eradication Types, Cabinet National Forest

Erad. Types	Acres Reconn.	Number of Ribes by Species per Acre			
		R. lacustre	G. inermis	R. viscosissimum	All Ribes
D.M.	2,020	4.1			4.1
O.M.	3,773	1.7			1.7
D.P.	2,905	.45		1.8	2.2
O.P.	913	.7	5.7		6.4
D.R.	580	2			2
O.R.	490			10	10
Stream	243	143.5		1.2	144.7
Brush					
Totals & Avgs.	10,924	4.8	.5	.95	6.2

TABLE NO. 16

Number of Acres Intensively Reconnaissanced, Classified According to Eradication Types and Number of Ribes Per Acre Classes
All Areas Worked--Montana

Erad. Type	Number R. lacustre per Acre Classes																			
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-125	126-150	151-175	176-200	201-250	251-300	301-400	401-500	501-750	Total
D.M.	2,875	1,225	640	65	90	135		140			123										5,292
O.M.	2,113	7,195	1,851	1,440	370	40	206	40	110		28										13,393
D.P.	2,617	725	295								70										3,707
O.P.	1,353	1,340	1,730	460		273	105		517	135											5,903
													120								1,710
O.R.	1,337	1,065	880	178	1120																3,580
Stream	20	9		20	11	32			34		20	68	39	74	27	78	43	120	44	36	677
Total	10,815	12,089	5,876	2,163	593	480	311	180	661	125	240	68	159	154	27	78	43	120	44	36	34,262

TABLE NO. 17

Total Number of Acres Reconnaissanced, Classified
According to Age Classes and Eradication Types
All Areas Worked--Montana 1927

Erad. Types	White Pine Type--Age Classes										Non-white Pine Types--Age Classes					
	1-10	11-20	21-40	41-60	61-80	81-100	101-200	200+	Not Classified	Total	21-40	101-200	200+	Not Classified	Total	
B.M.							4,472	1,570		6,042		489		3,218	2,707	Cabinet
O.M.							6,730	7,801		14,531		456	280	2,696	3,422	
D.F.			5,447	1,600		80				7,127				7,798	7,798	
O.P.		180	7,028	380	250	75				7,913	1,565			6,402	7,967	
D.B.	530	1,940								2,460				3,618	3,618	National
O.H.	355	4,350								4,705				1,319	1,319	Forest
Stream		128	117	37	4	7	305	251		849				37,962	37,962	Acres on Kootenai Nat'l Forest Not Classified
Brush																
Not Classified																
Total	885	6,588	12,592	2,017	254	162	11,507	9,622		43,627	1,565	945	280	62,013	64,803	

TABLE NO. 18

Number of Acres Intensively Reconnaissanced
Classified According to Eradication Types
and Number of Ribes Per Acre Classes
All Areas Worked--Montana

Erad. Type	Number of Ribes viscosissimum Per Acre Classes												
	0	1-10	11-20	21-40	41-50	51-60	61-70	71-80	81-90	91-100	101-125	126-150	Total
D.M.	2,875												2,875
O.M.	2,113												2,113
D.P.	2,617	710											3,327
O.P.	1,353												
D.R.	500	40	40								50		630
O.R.	1,337	1,800	[illegible]										2,137
Stream	20	14	6									5	45
Total	10,815	1,564	46								50	5	12,480

TABLE NO. 19

Number of Acres Intensively Reconnaissanced
Classified According to Eradication Types
and Number of Ribes Per Acre Classes
All Areas Worked--Montana

Eradication Type	Number of Grossularia inermis Per Acre Classes						
	0	1-10	11-20	21-30	31-40	41-50	Total
D.M.	890						890
O.M.	1,638						1,638
D.P.	2,015						2,015
O.P.	743						743
D.R.	350						350
O.R.							
Stream	6				4		10
Total	5,642				4		5,646

TABLE NO. 20

Number of Acres Intensively Reconnaissanced, Classified According to Eradication Types and Number of Ribes Per Acre Classes
All Areas Worked--Montana

Erad. Type	Number of All Ribes Per Acre Classes																			
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-125	126-150	151-175	176-200	201-250	251-300	301-400	401-500	501-750	Total
D.M.	2,875	1,225	640	65	90	135		140			122										5,292
O.M.	2,113	7,195	1,851	1,440	370	40	205	40	110		28										13,393
D.P.	2,617	1,435	295								70										4,417
O.P.	1,353	780	1,730	460		273	105		517	125											5,903
D.R.	500	440	480									50	120	80							1,670
O.R.	1,337	1,555	880	178	120																4,070
Str.	20	23	6	20	17	32			34		20	70	48	74	27	78	43	120	44	36	712
Total	10,815	13,213	5,882	2,163	597	480	311	180	661	125	240	120	168	154	27	78	43	120	44	36	35,457

TABLE NO. 21

Number of Ribes Per Acre by Ribes Species and Eradication Types, All Areas Worked, Montana

Erad. Types	Acres Reconn.	Number of Ribes by Species Per Acre			
		R. lacustre	G. inermis	R. viscosissimum	All Ribes
D.M.	5,292	12.1			12.1
O.M.	13,393	17			17
D.P.	4,417	5.8		1.2	7.2
O.P.	5,903	15.4	.9	0	16.4
D.R.	1,670	33.1	0	11.4	44.5
O.R.	4,070	1.2	0	2	9.2
Stream	712	191.3		1.7	193
Total & Avgs.	35,457	16.07	.15	.92	17.1

TABLE NO. 22

Distribution of Ribes by Species All Areas Reconnaissanced, Montana

Ribes Species	Per Cent of Total Acres Reconnaissanced Which Has		
	No. Ribes Per Acre	1-10 Ribes Per Acre	More Than 10 Ribes Per Acre
R. lacustre	31.6%	35.3%	33.1%
G. inermis	99.9%	0 %	.1%
R. visco.	86.6%	12.5%	.9%
All Ribes	30.6%	37.2%	32.2%

Table No. 23.
Comparison of Ribes Data by
National Forests, Montana

Forest	Acres Intensively Reconn.	Per Cent of Total Acres Reconnaissanced, Which Has		
		No Ribes Per Acre	1-10 Ribes Per Acre	More Than ten Ribes Per Acre
Kootenai National Forest	24,533	21.1%	33.5%	45.4%
Cabinet National Forest	10,924	51.7%	46.3%	2%
All Areas	35,457	30.6%	37.2%	32.2%

Table No. 24

Number of Ribes per Acre on
National Forests, Montana

Forest	Acres Intensively Reconn.	Average Number of Ribes by Species per Acre			
		R. lacustre	R. visco.	G. inermis	Total Ribes
Kootenai National Forest	24,533	21.1	.913		22
Cabinet National Forest	10,924	4.8	.95	.5	6.2
All Areas	35,457	16	.92	.15	17.1

PRE-ERADICATION SAVENAC NURSERY

C. H. Johnson
Assistant Pathologist

The pre-eradication work at Savenac Nursery was completed during the later summer so all is now in readiness to commence Ribes eradication as soon as the weather permits. The work at Savenac is principally a stream type eradication job. Areas exclusive of the stream are practically Ribes free.

The acreage of the stream type for a distance of one mile in every direction from the nursery was computed and all areas exclusive of stream type for a distance of one-half to one mile from the nursery scouted for Ribes. It remains to be determined which of the two methods, hand eradication or chemicals, will be resported to on the various streams. It is, however, an assured fact that both methods will be employed.

SCOUTING FOR BLISTER RUST NORTHWESTERN MONTANA

By
C. H. Johnson
Assistant Pathologist

Scouting for the blister rust was conducted in western Montana along all the important drainages. Considerable scouting was done in the northwestern part of the state along the international boundary. A large number of Ribes nigrum, and other wild species, were inspected in British Columbia principally along the Kootenai River. Inspections on cultivated black currants were made as far west as Cranbrook, British Columbia.

Following are the principal drainages scouted with species of Ribes found:

TABLE NO. 1

Scouting for the Disease Northwestern Montana
September and October 1927

Locality	Ribes Species Found	Number Inspected							
		R. nigrum	R. petiolare	R. cereum	R. lacustre	R. americanum	R. visco.	G. inermis	G. setosa
Bitter Root and Missoula Rivers & tributaries	R.nigrum,R.petiolarie,R.cereum,R.lacustre,G.setosa,G. inermis	300	1,540	6	740	25	0	2	26
Thompson and Clarks Fork rivers	R.americanum,R.lacustre,G.inermis	965	12		396	4	30	471	0
Bull River and tributaries	R.lacustre,R.visco. G.inermis				281		50	122	
Flathead River and tributaries	R.nigrum,R.petiolare R.lacustre	30	134		737		42	167	
Stillwater River and tributaries	R.petiolare,R.lacustre,R.visco.G. inermis		10		836		62	321	
Kootenai River and tributaries in Montana and British Columbia	R.nigrum.R.lacustre R.visco. G.inermis	1,400			560			2,630	

BLISTER RUST CONTROL WORK IN IDAHO
1927

The following is the memorandum of understanding under the terms of which the work in Idaho has been organized:

MEMORANDUM OF UNDERSTANDING
between
THE BUREAU OF PLANT INDUSTRY, U. S. DEPARTMENT OF AGRICULTURE
and the
IDAHO STATE DEPARTMENT OF AGRICULTURE - - - UNIVERSITY OF IDAHO
IDAHO STATE BOARD OF FORESTRY - - - POTLATCH TIMBER PROTECTIVE ASSOCIATION - - - CLEARWATER TIMBER PROTECTIVE ASSOCIATION - - - COEUR D'ALENE TIMBER PROTECTIVE ASSOCIATION - - - PEND OREILLE TIMBER PROTECTIVE ASSOCIATION - - - and THE PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION
relative to
Cooperative White Pine Blister Rust Control Work in Idaho,
Effective July 1, 1927.

----------oOo----------

A. The BUREAU OF PLANT INDUSTRY agrees to:

(1) Pay the salaries and necessary travel expenses of one or more employees who shall conduct such work;

(2) Assist in systematically locating and destroying cultivated black currants (Ribes nigrum) under state authority;

(3) Inspect plant shipments to supplement blister rust quarantines;

(4) Conduct experiments in control reconnaissance and local Ribes eradication, demonstrate the practical application of control practices, and obtain data on the spread of the rust; and

(5) Coordinate control activities of the several cooperating states and agencies by furnishing regional leadership and supervision, and to provide employees and the cooperating agencies with blister rust subject matter and technical information.

B. The IDAHO STATE DEPARTMENT OF AGRICULTURE agrees to:

(1) Pay the salaries and expenses and direct the work of one or more men who shall, during the proper season, inspect plant shipments for violations of blister rust quarantines;

(2) Use its regular employees, so far as their other duties permit, and direct their work in systematically locating and destroying cultivated black currants, scouting for white pine blister rust and inspecting nurseries for this disease; and

(3) Undertake such destruction of white pine or Ribes in Idaho and such enforcement of state laws as may be necessary for the effective prosecution of blister rust control work.

C. The UNIVERSITY OF IDAHO agrees to:

(1) Detail one member of the staff of the School of Forestry to this work throughout the field season and to permit him sufficient time during the rest of the year to supervise generally such work in Idaho;

(2) Make such studies, so far as the other duties of the staff of the School of Forestry will permit, as are considered necessary and advisable on the rate of growth of western white pine remaining on areas after logging, and the expected yield of second growth white pine stands;

(3) Examine, through the Department of Plant Pathology, all specimens suspected of being infected with the white pine blister rust when sent in by the field scouts and others, and keep the necessary records of such collections and examinations;

(4) Assist the Bureau of Plant Industry, through the University Extension Service, so far as practicable in the educational activities necessary to the effective conduct of the work.

D. The IDAHO STATE BOARD OF FORESTRY agrees to:

(1) Cooperate through its deputized agents, insofar as their other duties permit, in systematically locating cultivated black currants, scouting for white pine blister rust, and locating infected or potentially infected host plants;

(2) Cooperate directly, insofar as practicable, in promoting and assisting the various blister rust control activities carried on in the State.

E. The POTLATCH TIMBER PROTECTIVE ASSOCIATION agrees to:

(1) Contribute the services of its employees, insofar as their other duties will permit, in systematically locating cultivated black currants, scouting for the white pine blister rust on the forest lands of the Association, securing complete information concerning the age and quantity of white pine second growth on logged-off and burned-over land of the Association, and determining by field surveys the number and kinds of currants and gooseberries in timbered, logged-off and burned-over lands as a basis for determining the cost and feasibility of local control of white pine blister rust on these lands.

F. The CLEARWATER TIMBER PROTECTIVE ASSOCIATION agrees to:

(1) Contribute the services of its employees, insofar as their other duties will permit, in systematically locating cultivated black currants, scouting for the white pine blister rust on the forest lands of the Association, securing complete information concerning the age and quantity of white pine second growth on logged-off and burned-over land of the Association, and determining by field surveys the number and kinds of currants and gooseberries in timbered, logged-off and burned-over lands as a basis for determining the cost and feasibility of local control of white pine blister rust on these lands.

G. The COEUR D'ALENE TIMBER PROTECTIVE ASSOCIATION agrees to:

(1) Contribute the services of its employees, insofar as their other duties will permit, in systematically locating cultivated black currants, scouting for the white pine blister rust on the forest lands of the Association, securing complete information concerning the age and quantity of white pine second growth on logged-off and burned-over land of the Association, and determining by field surveys the number and kinds of currants and gooseberries in timbered, logged-off and burned-over lands as a basis for determining the cost and feasibility of local control of white pine blister rust on these lands.

H. The PEND OREILLE TIMBER PROTECTIVE ASSOCIATION agrees to:

(1) Contribute the services of its employees, insofar as their other duties will permit, in systematically locating cultivated black currants, scouting for the white pine blister rust on the forest lands of the Association, securing complete information concerning the age and quantity of white pine second growth on logged-off and burned-over land of the Association, and determining by field surveys the number and kinds of currants and gooseberries in timbered, logged-off and burned-over lands as a basis for determining the cost and feasibility of local control of white pine blister rust on these lands.

I. The PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION agrees to:

(1) Contribute the services of its employees, insofar as their other duties will permit, in systematically locating cultivated black currants, scouting for the white pine blister rust on the forest lands of the Association, securing complete information concerning the age and quantity of white pine second growth on logged-off and burned-over land of the Association, and determining by field surveys the number and kinds of currants and gooseberries in timbered, logged-off and burned-over lands as a basis for determining the cost and feasibility of local control of white pine blister rust on these lands.

J. IT IS MUTUALLY AGREED that:

(1) This memorandum may be terminated at any time by any one of the parties hereto by written notice, and may be amended by written mutual agreement;

(2) The cooperative plan of work in this memorandum will be followed as being the best method of control of white pine blister rust in Idaho;

(3) All official records and reports of work performed under this agreement shall be open to inspection by any or all parties to this agreement, that all findings of blister rust made by any party to this agreement shall be reported promptly to all other parties to this agreement, and that all specimens collected by any party to this agreement

which are suspected of being infected with blister rust shall be submitted promptly to the Bureau of Plant Industry for final determination;

(4) The results of the cooperative work may be published jointly, or upon mutual agreement by one of the cooperating parties, due credit being given to the cooperating agencies. All manuscripts therefor shall be criticised by the cooperating parties before publication; and all form letters, bulletins and any other circulars to be mailed in penalty envelopes shall be submitted in manuscript form for approval by the Bureau of Plant Industry before being printed or distributed;

(5) Obligations by the Bureau of Plant Industry are contingent upon appropriations being made therefor by Congress; and no funds of the United States shall be expended in compensation for host plants destroyed in control work; and

(6) For the Fiscal Year 1928, the Bureau of Plant Industry shall contribute in value approximately $78,000 to the support of this cooperative work, the Idaho State Department of Agriculture shall contribute in value approximately $1,100, the University of Idaho approximately $4,000, the Potlatch Timber Protective Association approximately $3,800, the Clearwater Timber Protective Association approximately $3,800, the Coeur d'Alene Timber Protective Association approximately $3,800, the Pend Oreille Timber Protective Association approximately $3,800, and the Priest Lake Timber Protective Association approximately $4,340; thereafter the amount to be contributed by each shall be determined and agreed upon by supplemental correspondence.

Date:	Signature:
7-20-27	(s.) John S. Welch Commissioner, Idaho State Department of Agriculture.
July 31, 1927	(s.) F. G. Miller University of Idaho.
Aug. 9, 27	(s.) Ben E. Bush State Forester, Idaho State Board of Forestry.
Aug.25-27	(s.) A. W. Laird President, Potlatch Timber Protective Association.
Sept.12-27	(s.) Theo Fohl Secy-Treas.,Clearwater Timber Protective Association.
Sept.16-27	(s.) Sig Hofslund Secretary, Coeur d'Alene Timber Protective Association.
Sept.21-27	(s.) T. L. Greer Secretary, Pend Oreille Timber Protective Association.
Sept.27-27	(s.) J. Jensen Secretary, Priest Lake Timber Protective Association.
Oct.5, 1927	(s.) Wm. A. Taylor Chief, Bureau of Plant Industry.

REPORT ON BLACK CURRANT ERADICATION WORK IN IDAHO

by
C. R. Stillinger
Associate Pathologist

The eradication of the black currant in Idaho during 1927 was carried out as a cooperative project between the Bureau of Plant Industry, U. S. Department of Agriculture, and the Idaho State Department of Agriculture, under the terms of the cooperative agreement between these two agencies for the fiscal year of 1927 and 1928.

1. Object of the Project.

The object of the project during 1927 has been to continue the thorough eradication of the cultivated black currant in that portion of Idaho which had not been eradicated as well as to check the work which had been done in the northern counties.

11. Personnel

Eight men and 4 cars were employed in this work. Two men with one car did the rechecking work in northern Idaho from May 2 until August 1. Six men with three cars did eradication work in southern Idaho from June 30 to September 10.

111. Results.

The black currant eradication program was completed at the end of this season. During 1927 the following plantings were eradicated:

County	Number of Plantings	Number of Bushes
Bannock	60	711
Bear Lake	95	734
Benewah *	1	4
Bonner *	8	42
Boundary *	12	48
Caribou	10	126
Franklin	60	525
Fremont *	17	115
Kootenai *	10	69
Madison	9	83
Oneida	87	798
Shoshone *	17	57
Teton	42	442
Totals	428	3,754

* Counties in which recheck work was done. All of Idaho north of the St. Joe River was rechecked, as well as all of Fremont, Butte and part of Custer county in southern Idaho. Most of the bushes that were found on the recheck were from two to four years old.

Section I

OUTLINE OF RESEARCH WORK FOR 1927-1928

By

H. R. Offord,

Agent

After a careful survey of chemical eradication work as it now stands, four very important facts present themselves for our consideration. They are:

1. R. petiolare can be more efficiently and economically eradicated by chemical than by hand pulling.

2. G. inermis and R. lacustre have not been efficiently eradicated by chemical as yet.

3. G. inermis and R. lacustre are frequently associated with R. petiolare and should be included in any emergency delay program involving the eradication of this type.

4. The present cost of chemical and the concentration of this chemical which is used at present can be cut in half if we could set up the proper conditions in a more dilute solution.

The explanation of the difference in reaction on the part of the species mentioned is a fundamental one and the solution of the problem lies in the field of research. The need is a vital and urgent one, and at the termination of our field season our program of research should be pushed ahead with all possible speed and assistance. The help of men trained in chemistry, physiology and botany and who are familiar with the problem of blister rust will be necessary in order to carry out the research work outlined as follows:

A. Material for Experimental Work

1. Root and stem cuttings of G. inermis and R. petiolare gathered by Rockie and Bell in Idaho. Part of these plants to be started at once in the greenhouse, part to be planted at once out-of-doors and remainder to be kept in cold storage over the winter and started in early spring.

2. Leaves and stems of R. petiolare, G. inermis, R. lacustre and R. viscosissimum. Gathered in Idaho following instructions sent by wire to Mr. Wyckoff.

3. Ribes seedlings of each of the above four species to be grown on sand cultures in greenhouse at California, gathered by Rockie and Bell in Idaho.

4. R. nigrum obtained by Mr. Root in California.

5. Cultivated red currants (if necessary) purchased from California nurseries.

B. Morphology

This field should provide the anatomical data which are factors in the difference of susceptibility to chemical treatment and will be invaluable in our studies of Ribes Ecology and of disease host plants. Both leaves and stems should be studied as:

1. A detailed study of the stomata and lenticels of the above four species. This comparative study to cover size, number, and manner of distribution of stomata and lenticels. Work performed by Patty.

2. A comparative study of the morphology of stem of the above Ribes. Work by Patty.

C. Physiology

Data of this sort are necessary to bridge the gap between botanical and chemical data, and will enable us to make a much more extensive application of our results.

1. Physiological studies of the structure and composition of Ribes tissue employing the micro-chemical technique as worked out by J. F. Priestley at the University of Leeds, England. If work can not be satisfactorily done in England, a fellowship might be established by the International Education Board.

D. Chemistry

Comprises the bulk of our investigational work and intends to answer the following important questions:

1. How can we establish a measuring stick to express the toxicity of a chemical on Ribes?

2. What is the nature of this toxic action on the Ribes tissue?

3. Under what conditions of temperature, moisture and light (field conditions) is this toxic action optimum?

The work outlined is as follows:

I. Absorption studies - Offord and d'Urbal with advice of Dr. Hoagland.

a. Ribes to be grown on sand cultures and provided with nutrient

solutions.

b. Careful experiments to see if Ribes can be killed by application of the chlorate to leaves and stems.

c. Ribes seedlings on sand cultures to be treated with chlorate under varying conditions of light and moisture. These experiments to be duplicated using the relatively non-toxic chloride.

d. Ribes seedlings on sand cultures to which are added nutrient solutions containing various amounts of chlorate to determine the action of the toxic anion if it enters through the roots.

e. Addition of varying amounts of manganese (known to stimulate oxidation in plant tissue) to the chlorate sprays and to the nutrient solutions. Traces of iron and ethylene gas to be considered.

f. Testing of chlorate sprays containing different and known concentrations of the hydrogen ion.

g. Analysis of specimens of R. petiolare and G. inermis stem sampled from sprayed bushes at Bovill, Idaho. Ribes sprayed with sodium chlorate to be compared with controls in each case.

h. Absorption studies on Nitella. Work on this cell which does not present the same difficulties as the more complex higher plants will give us data on the action of the chlorate ion on cell organization. Material collected in Golden Gate Park, San Francisco.

II. Chemical analysis of Ribes

A gross analysis of Ribes tissue must be made before we can attack the problem of difference in susceptibility of various species, from the chemical side. After an analysis of the normal healthy plants has been made, Ribes plants should be taken at several points along the death curve and a similar analysis made. This work should be done preferably by a trained plant chemist at the University of California with the advice of Professor Dore. Analyses to be made according to existing technique and to include determination of: Cutin, suberin, lignin, pectic substances, cellulose, carbohydrates, tannins, alkaloids, essential oils, glucosides, etc.

III. Ultimate analysis of technical grades of sodium chlorate to determine what impurities they contain. A trace of iron or manganese may be catalysing the action of the technical grade of chlorate which is better than that of the C. P. Work by Youden and Offord.

IV. Investigation of the possibility of determining quantitavely mixtures of chloride and chlorate present as such in Ribes tissue by some method other than oxidation of the organic material. Work by Youden and Offord.

V. Investigation of the action of two oxidizing agents. Application of one type (caustic) to partially break down the cuticle before application of the passively oxidizing agent ($NaClO_3$). Particular attention to G. inermis.

Acknowledgements

The writer particularly wishes to thank the Division of Forestry in the person of Dr. Mulford, and the Division of Plant Nutrition in the person of Dr. Hoagland for their assistance and helpful suggestions both in the work carried out during the past winter and in the preparation of work for the coming winter.

REPORT ON THE INVESTIGATION OF THE TOXIC ACTION OF HALOGEN AND OXY-HALOGEN COMPOUNDS AS RELATED TO THE CHEMICAL ERADICATION OF RIBES

Purpose of the Investigation

Analysis of the results of field experiments shows that even our best killing agent varies considerably in its action on Ribes. Factors of temperature, sunlight, moisture and chemical composition of the soil, which factors are responsible for the physiological condition of the plant, very probably explain this difference in susceptibility to various toxic agents.

This research program has been instituted in the hopes of determining the "mechanism of action" of our chemicals on Ribes, and to determine if possible, under what conditions of sunlight, moisture and soil this action is optimum. A satisfactory understanding of this basic problem is vital to the intelligent management of our field work and should be the foundation upon which our permanent methods of control work are based.

With these ideas in view, the Office of Blister Rust Control through the cooperation of the Division of Forestry and Division of Plant Nutrition, University of California, who provided office, greenhouse, and laboratory space, started work on this program of research in September, 1926.

Preparation of Plant Material

Several thousand root cuttings of each of the species of R. petiolare, G. inermis and R. lacustre were shipped from Idaho to California in the early fall of 1926. The greater portion of this material was planted in a tract of land allotted to us by the Forestry Division of the University of California. These plants showed promise shortly after planting, but a period of frost, followed by several weeks of very heavy rains killed most of the cuttings. Species of R. hallii (14), R. cereum (12), R. nevadense (8), and G. roezli (15), which were sent to Berkeley

from eastern California did not survive under greenhouse conditions. Sixty-eight R. petiolare, 54 G. inermis and 48 R. lacustre were also carefully potted, but only a few healthy, vigorous plants were obtained from these specimens. None of the wild material was subsequently used in the experimental work. After failure to obtain a supply of wild Ribes, some cultivated red currants were purchased from a local nursery and under greenhouse conditions soon reached a stage of development suitable for experimental work.

Working Over of the Laboratory Technique.

Since the writer was chiefly interested in the action of $NaClO_3$ and NH_4Cl on Ribes, it was decided to study the absorption, if any, of chemicals of this toxic type and compare it with the absorption of the non-toxic type such as NaCl and KBr. The halogens readily lent themselves to quantitative measurements, so it was purposed to use a quantitative measurement of the halogen content of Ribes tissue as an indicator of the amount of absorption.

The technique used was essentially that of P. L. Hibbard, Ind. Eng. Chem. Vol. 18, and it was found to be quite satisfactory even when a large amount of organic matter was present in the sample taken for analysis. In the summary of the procedure, several minor changes are noted in the quantity of reagents used and in one or two small details of the apparatus. Blank solutions containing known amounts of chloride, chlorates, bromides and bromates were used to test the accuracy of the procedure. Table I gives a few of the data which are indicative of results obtained.

Table I

C.C. 0.01N $Na_2S_2O_3$	Halogen Taken Mg.	Halogen Found Mg.	Error in Mg.	Remarks
5.67	Br. - 4.610	Br. -4.526	-0.084	KBr used
5.73	" - 4.610	" -4.584	-0.026	" "
2.28	" -11.844	" -1.824	-0.020	" "
2.65	" - 1.844	" -2.120	+0.276	" "
2.23	" - 1.844	" -1.784	-0.060	" "
12.70	Cl. - 6.00	Cl. -4.510	-1.490	NaCl "
12.66	" - 6.00	" -4.49	-1.51	" "
12.60	" - 6.00	" -4.48	-1.52	" "
25.32	" -10.70	" -8.99	-1.71	$NaClO_3$ "
11.93	" - 4.28	" -4.24	-0.04	" "
3.18	Br. - 2.42	Br. -2.54	+0.12	$KBrO_3$ "
2.89	" - 2.42	" -2.31	-0.11	" "
2.93	" - 2.42	" -2.34	-0.08	" "

Blank tests on reagents and untreated Ribes stems were run. Average results were as listed on Table II.

Table II

C.C. 0.01N $Na_2S_2O_3$	Material Tested	% of Halogen Found
None	Ribes stem untreated	Bromine - None
1.29	Ribes stem untreated	Chlorine -0.622
.84	Total - Reagent	Chlorine -0.405
.86	Total - Reagent	Chlorine -0.413
.75	Total - Reagent	Chlorine -0.365
None	Ribes stem untreated	Bromine - None

In this manner the proper technique for the quantitative determination of halogen in Ribes stem was worked over until the writer was satisfied as to the accuracy of his work.

Treatment of Plant Material

Cultivated red currants and subsequently a few cultivated black currants were used in the experiments. Four series of experiments were carried out, viz:-

1. Plants placed in greenhouse under normal greenhouse light and given 1/2 liter of distilled water per week.

2. Plants placed in greenhouse under normal greenhouse light and kept without water after the application of the chemical.

3. Plants placed in dark box in greenhouse and kept without water after application of the chemical.

4. Plants left outside under normal conditions of light and moisture.

The plants of each of the series were treated with the chemicals according to one or all of the following plans:

Application to:

1. Upper and lower leaf surface and stem.
2. Upper leaf surface and stems.
3. Stems alone.
4. Leaves alone.

In each of the above instances, the pots were covered with a large piece of filter paper and paraffin paper to preclude the possibility of the chemicals poisoning the soil. A small atomizer was used in order to accurately apply the mist spray. The chemical was applied

to the stems alone by means of a small camel's hair brush. In order to get a fine spray upon the leaves, it was found necessary to first carefully wrap the aerial stems of the plant in a layer of filter paper and then a covering of paraffin paper. Tables III, IV. V, VI, VII, summarize the greenhouse data:

Table III

Plants given ½ liter distilled water per week and kept under normal greenhouse light.

Chemical Used and Concentration	Plant No.	Applied To	Species
$NaClO_3$ - 20%	1	Leaves of upper and lower surface and stems	Cultivated red currant
" "	2	Leaves of upper surface and stems	" " "
" "	3	Stems only	" " "
KBr - 5%	4	Leaves of upper and lower surface and stems	" " "
" "	5	Leaves of upper surface and stems	" " "
" "	6	Stems only	" " "
$KBrO_3$ - 3.1%	7	Leaves of upper and lower surface and stems	" " "
" "	8	Leaves of upper surface and stems	" " "
" "	9	Stems only.	" " "
NaCl - 10%	10	Leaves of upper and lower surface and stems	" " "
" "	11	Leaves of upper surface and stems	" " "
" "	12	Stems only	" " "
NH_4Cl - 20%	13	Leaves of upper and lower surface and stems	" " "
" "	14	Leaves of upper surface and stems	" " "
" "	15	Stems only	" " "
" "	16	Leaves only	" " "
$NaClO_3$ "	17	Leaves only	" " "
KBr - 5%	18	Leaves only	" " "
$KBrO_3$ - 3.1%	19	Leaves only	" " "
NaCl - 10%	20	Leaves only	" " "
None	37	Control - no treatment	" " "

Table IV

Plants kept without water in dark box.

Chemical Used and Concentration	Plant No.	Applied To	Species
$NaClO_3$ - 20%	21	Leaves - upper and lower surface and stems	Cultivated red currant
" "	22	Stems alone	" " "
KBr - 5%	23	Leaves - upper and lower surface and stems	" " "
" "	24	Stems alone	" " "
$KBrO_3$ - 3.1%	25	Leaves - upper and lower surface and stems	" " "
" "	26	Stems alone	" " "
NaCl - 10%	27	Leaves - upper and lower surface and stems	" " "
" "	28	Stems alone	" " "
NH_4Cl - 20%	29	Leaves - upper and lower surface and stems	" " "
" "	30	Stems alone	" " "
None	36	Control - no treatment	" " "

Table V

Plants kept without water under normal greenhouse light.

Chemical Used and Concentration	Plant No.	Applied To	Species
$NaClO_3$ - 20%	31	Leaves- upper and lower surface and stems	Cultivated red currant
KBr - 5%	32	Leaves - upper and lower surface and stems	" " "
$KBrO_3$ -3.1%	33	Leaves - upper and lower surface and stems	" " "
NaCl - 10%	34	Leaves - upper and lower surface and stems	" " "
NH_4Cl - 20%	35	Leaves - upper and lower surface and stems	" " "
None	38	Control - no treatment	" " "

Table VI

Plants placed outside under normal conditions of light and moisture

Chemical Used and Concentration	Plant No.	Applied to	Species
$NaClO_3$ - 20%	39	Leaves - upper and lower surface and stems	Cultivated red currant
$KBrO_3$ -3.1%	40	Leaves - upper and lower surface and stems	" " "
NH_4Cl - 20%	41	Leaves - upper and lower surface and stems	" " "
None	42	Control - no treatment	" " "
$NaClO_3$ - 20%	46	Leaves - upper and lower surface and stems	" black "
" "	48	Leaves - upper and lower surface and stems	" red "
" "	49	Leaves - upper and lower surface and stems	" " "

Table VII

Plants given ½ liter of distilled water per week and kept under greenhouse light.

Chemical Used and Concentration	Plant No.	Applied to	Species
$NaClO_3$ - 20%	43	Leaves - upper and lower surface and stems	Cult. black currant
$KBrO_3$ -3.1%	44	Leaves - upper and lower surface and stems	" " "
NH_4Cl - 20%	45	Leaves - upper and lower surface and stems	" " "
None	47	Control - no treatment	" " "

Notes on Treatment of Plants

1. $NaClO_3$ -20% by volume contained 0.6% by volume of glue, added as a sticker and spreader.
   KBr - 5% by volume contained 0.3% by volume of glue.
   $KBrO_3$- 3.1% by volume contained 0.3% by volume of glue.
   NaCl - 10% by volume contained 0.4% by volume of glue.
   NH_4Cl - 20% by volume contained 0.6% by volume of glue.

2. Plants 1-47 (except controls) were treated in late afternoon, during bright, warm weather.

3. Plants 39-41 were sprayed inside greenhouse and then placed out-of-doors. A heavy rainstorm occurred during the first night of the experiment.

4. Plant No. 48 - sprayed with $NaClO_3$ 5:00 P.M. No sticker or spreader used.

Plant No. 49 - sprayed with $NaClO_3$ 11:30 A.M. No sticker or spreader used. Weather fine and warm with clear, cold nights after application.

Observations on Ribes After Chemical Treatment

1. Three days after $NaClO_3$ treatment. Plant No. 1 had several leaves begin to darken in spots. No other plants affected by chemicals.

2. Eight days after treatment. $NaClO_3$ and NH_4Cl began to turn leaves a brown color. No visible effects on stem-treated plants. $KBrO_3$, NaCl, and KBr exhibit no results of chemical's action.

3. Sixteen days after treatment. $NaClO_3$ had much greater effect on plants placed outside than on greenhouse plant. Plant in greenhouse which received no water less noticeably damaged than one receiving $\frac{1}{2}$ liter of distilled water per week. Plants treated with NH_4Cl did not show same differentiation between those given water and those kept without it. NH_4Cl showed very slight action on plant left outside. $KBrO_3$ had a slight effect on plant placed outside but none on greenhouse plant. KBr and NaCl - no observed effect.

4. Six days after treatment. The leaves of plant which had been left outside were quite brown, while leaves of greenhouse plant treated 22 days previous were merely spotted.

5. Twenty-one days after treatment. Plants which had been left in dark box were removed and examined. $NaClO_3$ had turned the leaves somewhat darker in color but no browning action had taken place. Action of NH_4Cl about same as that of $NaClO_3$. In absence of light, the chemical has an indifferent action.

Analysis of Treated Ribes

After a period of twenty-one days several samples of stem were cut from different parts of the Ribes plants. The stems were then cut into millimeter sections by means of a sharp razor and in the case of samples taken for analysis as shown in columns 2 and 3 of Table VIII, the layer of cortex was removed from the woody stem. Samples were then dried in a drying oven at a temperature of 85 to 90°C for a period of seven days. The material was ground in a small grinding machine and further reduced to a fine powder in a mortar. Samples were kept in tightly stoppered shell vials prior to analysis.

The halogen was then quantitatively determined according to the technique of P. L. Hibbard: Ind. Eng. Chem. Vol. 18, No. 8, page 826, August, 1926. The procedure which the writer followed included a

few minor changes in amounts of reagents used in order to adapt the procedure to the use of larger amounts of organic material. A sample of prepared Ribes stem (0.07-0.09 gm.) is weighed on a clean watch glass and later removed to a 100 C.C. nickel crucible and the material moistened with a little water. 0.8 -1.0 gms. of Na_2O_2 is added and the lid placed on the crucible to prevent loss from effervescence. When the action has subsided, add a drop of alcohol and rinse the crucible lid and sides of the crucible. Warm gently on a steam bath until effervescence has ceased and then evaporate to dryness on a steam bath. Dry on a hot plate at 100° C. for about an hour. The mixture is then ignited at a low temperature. An electric muffle furnace is preferable but ignition over a low Bunsen flame may be substituted if it is very carefully done. The crucible should not be allowed to reach a dull, red heat. When the fusion is cool, dissolve in about 25 c.c. of distilled water and filter. If difficulty is experienced in filtering the strongly alkaline solution, neutralize a portion of the alkali by means of 5N-H_2SO_4 keeping the solution alkaline for this part of the procedure. Rinse the crucible carefully and wash the carbonized material. From 100 - 125 cc. of wash water is necessary to remove the last trace of halide from the remaining carbon. To the filtrate while still alkaline add (1-2) gms. Na_2HSO_3 to reduce any halogen which might have become oxidized during the ignition. Add a drop of methyl orange and run in 5N-H_2SO_4 until slightly acid. Place a convenient sized watch glass on the beaker and boil on a hot plate until the excess of SO_3 has been removed. Cool, make slightly alkaline and evaporate to a volume of 10 c.c. on a steam bath.

The sample, ready for analysis, is transferred to the chlorine or bromine apparatus as the case may be. For the chlorine analysis add 1 c.c. of saturated $KMnO_4$ solution and 1 c.c. 5N-H_2SO_4. The volume of the liquid for distillation should be 25-20 c.c. Heat on a Woods alloy bath and distill over the liquid at about 125° C. The liberated chlorine is titrated as it comes over by means of .01 N-$Na_2S_2O_3$. The liquid in the distilling flask should be evaporated to dryness in order to remove the last trace of chlorine. The number of c.c. of $Na_2S_2O_3$ used, multiplied by the factor 0.355 gives the number of milligrams of chlorine in the sample.

For the bromine analysis, transfer the liquid to the apparatus, keeping the volume as low as possible. 12-15 c.c. was found to be very satisfactory. Add 1 c.c. 5N-H_2SO_4 and 1 gm. of fresh chromium anhydride, CrO_3 for each c.c. of liquid contained in the tube. Connect at once to the absorber and titrate the liberated iodine as the bromine comes over. When no blue color appears after 3 to 4 minutes, the reaction may be considered as complete. The number of c.c. of .01 N-$Na_2S_2O_3$ used multiplied by the factor 0.8 gives the milligrams of bromine present in the sample.

a. Notes on Procedure.

1. It was found desirable to use a 10 c.c. standardized Mohr pipette instead of a 50 c.c. burette in the chlorine apparatus, since we were

measuring relatively small amounts of chlorine. A rubber connection with a small glass bead was found most satisfactory for these small measurements. A fine piece of wire arranged after the fashion of a peep sight and which could be moved over the length of the pipette was most useful in measuring small changes in the position of the meniscus. By using a hand lens, a difference of 1/100 of a c.c. could be fairly accurately determined.

2. A side filler on the Mohr pipette was found to be the most convenient method of filling the pipette.

3. $Na_2S_2O_3$ solution was made up by dissolving an accurately weighed portion of the C P crystal in distilled water that had been previously boiled and cooled out of contact with the air. The solution was then kept in 200 c.c. black enamelled storage bottles which connected directly with the Mohr pipette by means of a side tube. Air inlets on the storage bottle and Mohr pipette were protected by means of soda-lime tubes.

4. Fresh solutions of starch indicator, potassium iodide and sodium thiosulphate were made up twice a week.

b. Results of analyses.

The figures in the following tables are the average of two or more samples of Ribes stem:

Table VIII

Plants given water and kept under normal greenhouse light.

*Percentage of Halogen Found in Ribes Stems After Application of Spray to					
Chemical Used and Concentration	Leaves, Upper & Lower Surface and Stems		Leaves, Upper Surface and Stems	Leaves, Upper Surface and Lower Surface.	Stems Only
	Bark	Woody Stem			
$NaClO_3$ - 20 %	5.42	1.11	1.89	0.643	1.46
NaCl - 10 %	4.62	1.49	1.79	0.739	1.37
NH_4Cl - 20 %	3.57	1.33	1.32	1.17	1.90
KBr - 5 %	2.00	Faint Trace	0.29	Trace	0.286
$KBrO_3$ - 3.1% (sat.)	0.712	None	0.145	Faint Trace	0.175

Control Plants - for chlorine - 0.622%
Control Plants - for bromine - None.

*Samples of Ribes stem were cut from the treated plants after 21 days. Stems were then cut into millimeter sections by means of a sharp razor and in the case of samples taken for columns 2 and 3 above, the layer of cortex was separated from the remainder of the stem. Samples were then dried for 7 days in a drying oven at temperature 85-90° C. Halogen content was then quantitatively determined. Technique of P.L.Hibbard: Ind. Eng. Chem. Vol. 18, No. 8, page 836, August, 1926.

Table IX

*Per Cent of Halogen in Ribes Stem After Application of Chemical To:

Chemical Used & Concentration	Leaves, Upper & Lower Surface and Stems	Stems Only
$NaClO_3$ - 20%	1.35	1.53
NaCl - 10%	2.28	1.68
NH_4Cl - 20%	2.49	2.12
KBr - 5%	0.67	0.27
$KBrO_3$ -3.1%	0.08	0.15

Control Plants - Chlorine - 0.748
Control Plants - Bromine - None.

*The above plants received 1/2 liter of distilled water and were then placed in a dark box where they were kept until their subsequent sampling and analysis, 21 days later. Procedure was then as explained under Table I.

Table X

Plants Kept Without Water Under Normal Greenhouse Light

* Per cent of Halogen in Ribes Stem After Application of Chemical to:	
Chemical Used and Concentration	Leaves, upper and Lower Surface and Stems
$NaClO_3$ - 20%	1.64
NaCl - 10%	2.30
NH_4Cl - 20%	2.53
KBr - 5%	0.26
$KBrO_3$ - 3.1%	0.04

Control Plants -- Chlorine - 0.823%
Control Plants -- Bromine - None

*The above plants received no water after application of the chemical and were placed under normal conditions of greenhouse light and moisture. Sampled and analyzed as previously stated.

Table XI

Plants Placed Outside Under Normal Conditions of Sunlight and Moisture.

*Per cent of Halogen in Ribes Stem After Application of Chemical to:		
Chemical Used and Concentration	Leaves, Upper and Lower Surface and Stems	
	Woody Stem	Bark
$NaClO_3$ - 20%	0.962	1.50
NH_4Cl - 20%	0.77	
$KBrO_3$ -3.1%	0.06	

Control Plants -- Chlorine - 0.624%
Control Plants -- Bromine - None.

*The above plants were sprayed and then placed outside and left under the normal conditions of moisture and full sunlight for a period of 21 days. Sampled and analyzed as previously stated.

Table XII

Halogen Content of the Ash of Ribes Plants Placed Under Different Conditions of Light and Moisture.

Conditions	% Chlorine	% Bromine
1. Pots filled up with tap water two and three times each week. Full greenhouse light.	0.622	None
2. Plants given ½ liter of distilled water per week. Full greenhouse light.	0.648	None
3. Plants left in the full sunlight of outdoors and normal moisture as provided by varying weather.	0.624	None
4. Plants placed in a dark box and kept without water.	0.748	None
5. Plants kept without water. Full greenhouse light	0.823	None

Table XIII

Halogen Content of Ribes Stem After Immersion in Solutions of Halide and Oxy-halogen Compounds.

Chemical Used and Concentration	% Halogen Present After Treatment of Live Stem	% Halogen Present After Treatment of Dead Stem
$NaClO_3$ - 25%	7.90	7.76
$NaClO_3$ -3.1%	3.19	--
NaCl - 10%	8.14	--
NH_4Cl - 20%	13.02	10.28
$KBrO_3$ -3.1%	1.09	0.70
KBr - 20%	15.29	9.95
KBr -3.1%	4.92	--

Above samples of live and dead Ribes stem were cut from greenhouse plants, sectioned into millimeter sections by means of a sharp razor. The prepared samples were then immersed in the above solutions for 24 hours, dried on filter paper before placing in a drying oven at 85 to 90 degrees Centigrade for seven days. After grinding and powdering 0.5-0.1 gram samples were taken and the Halogen content determined according to the method previously mentioned.

Table XIII - A

No. of Root Sample	Chemical Used in Treatment	Manner of Application of Chemical	Conditions under which plants were kept.	Per cent Chlorine Found
1R.	$NaClO_3$	Leaves, Upper and Lower Surface and Stems	1/2 liter distilled H_2O per week. Normal greenhouse light.	1.20
37R.	Control	"	"	0.85
10R.	NaCl	"	"	1.04
13R.	NH_4Cl	"	"	0.80
21R.	$NaClO_3$	"	No water after app. of chemical. Kept in dark box. Normal greenhouse light.	1.05
36R.	Control	"	"	0.74
31R.	$NaClO_3$	"	No water. Normal greenhouse light.	0.87
38R.	Control	"	"	1.00
42R.	Control	"	Placed outside under normal light and moisture.	1.03
47R.*	Control	"	"	1.03
43R.*	$NaClO_3$	"	"	0.94
48R.	$NaClO_3$	"	"	0.74
49R.	$NaClO_3$	"	"	0.85

*Cultivated Black Currants.
Remainder Cultivated Red Currants as in Stem experiments.

Table XIV

Condition	Chemicals Compared	Difference in %
I	$NaClO_3$ -NH_4Cl	+0.57
II	" "	-1.14
III	" "	-0.89
I	$KBrO_3$ -KBr	-0.145
II	" "	-0.59
III	" "	-0.22
I	$NaClO_3$ -NaCl	+0.10
II	" "	-0.93
III	" "	-0.66

Note: Condition I = + M + L = Moisture and light.
" II = - M - L = No moisture and no light.
" III = - M + L = No moisture and light.

Table XV

Per Cent Halogen in Ribes Tissue

Series No.	$NaClO_3$	NaCl	NH_4Cl	$KBrO_3$	KBr
I + M + L	1.89	1.79	1.32	0.145	0.29
II - M - L	1.35	2.28	2.49	0.08	0.67
III - M - L	1.64	2.30	2.53	0.04	0.26

Table XVI

Same as Table XV--Less Control Factor

Series No.	$NaClO_3$	NaCl	NH_4Cl	$KBrO_3$	KBr
I + M +L	1.27	1.17	0.70	0.145	0.29
II - M - L	0.60	1.53	1.74	0.08	0.67
III - M + L	0.82	1.48	1.71	0.04	0.26

Discussion of Results

Although the data show a slight increase in the chlorine content of the woody stem of sprayed Ribes over that of the untreated plants, the difference is of the same order of magnitude as the amount of chlorine originally found present. Examination of the chlorine content of our controls, which were placed under different conditions of light and moisture indicates that Ribes are able to concentrate in their tissue different amounts of chlorine, depending upon the external factors of moisture and sunlight. The observed increase in chlorine content of the woody stem is consequently not indicative of absorption having taken place through the leaves and stems. It is quite possible the bromine analysis in the case of the cambium and woody stem after potassium bromate treatment failed on account of the small concentration of bromate ion which might have been masked by the much larger amount of chlorine present. In the analysis of the entire stem, the presence of bromine in Ribes tissue after treatment with the bromide and bromate is comparable with that of the chlorine found, if we take into consideration the smaller concentration of bromide and bromate used.

No consistent relationships are shown by comparison of the data obtained on analysis of plants where the different chemicals were applied to leaves and stem, leaves alone, stem alone (See Table VIII). The order of magnitude of any difference is obviously small. However, if we arrange the data of any one method of treatment (stems and leaves upper and lower surface) as it is done in Tables XIV, XV, XVI, several interesting points suggest themselves.

The difference between the amount of halogen found present in the Ribes tissue after treatment with $NaClO_3$ and NaCl respectively is greatest under conditions of optimum moisture and sunlight, the latter factor appearing as the more important of the two. Comparison of the bromate and bromide indicates that sunlight has the same limiting effect on the amount of the halogen present. Reference to Table XVI indicates that the chlorate and bromate alone follow this order of variance with changing conditions of moisture and sunlight. Although the smaller quantity of bromate determined renders the data prone to larger errors, it is interesting to note that the bromate acts similarly to the chlorate and we find that the bromate is also accumulated to the greatest extent under optimum light and moisture. Table XVI shows that the chloride and bromide content of Ribes tissue is greatest under conditions of minimum light and moisture. These data indicate that the chlorate and bromate are the only ones found in greatest concentration under maximum moisture and sunlight. In view of our field observations, which show sodium chlorate to be so much more effective than any of the other chemicals, this may be a significant fact.

Data from root analyses of treated plants do not indicate any absorption of the halogen into the root parts of the plant. In some cases values for the controls are higher than those of treated plants. The

highest value for chlorine is again given by roots of plants treated with chlorate and kept under optimum moisture and full greenhouse light.

Summary

1. The amount of halogen present in Ribes tissue after treatment with sodium chlorate is greatest under optimum conditions of moisture and light. This also holds good for the potassium bromate, but we find that the halogen from sodium and ammonium chloride and potassium bromide treatment, is present in greatest amounts when the plants are kept under minimum light and moisture.

2. Absorption, if any, is small in magnitude and probably local in nature when the above chemicals are applied to the aerial parts of Ribes.

3. No increase is observed in the halogen content of the roots after application of the chemical to the aerial parts of plants.

4. Action of chlorate is much faster on Ribes placed in full sunlight than on greenhouse plants where a partial exclusion of the ultraviolet end of the spectrum occurs.

5. Action of chlorate is much faster on greenhouse plants receiving 1/2 liter of distilled water per week than on greenhouse plants which received no water after application of the chemical.

6. Action is more rapid in the case where chlorate is applied to the lower leaf-surface than when it is applied to the upper surface.

7. No visible effects two weeks after chlorate is applied to the stems alone.

8. Applied to the leaves alone, the action is apparently the same as in the case of application to the stems and leaves.

9. Plants treated with chlorate and placed in a dark box, with no water after application of the chemical showed comparatively little browning of the leaves.

10. Results to date suggest that the toxic action of sodium chlorate is due to a slow change of the chlorate over to the perchlorate form under the actinic influence of the sun with the liberation of nascent oxygen. Nascent oxygen can either diffuse through lenticels and stomata and act directly on the living cells or by virtue of its powerful oxidizing action, break down the cutinized material itself until diasmosis can take place freely through the oxidized cuticle. The entire plant is killed to the ground in this manner and the roots and crown die due to starvation and winter kill.

This suggested explanation opens up a very interesting field of investigative work. It appears to the writer that those compounds which are able to liberate a gaseous constituent under field conditions would create a highly toxic medium for Ribes and this field of possible Ribes killers is being carefully investigated.

Section II

REPORT ON THE PROGRESS OF CHEMICAL ERADICATION IN THE WEST

By
H. R. Offord
Agent

I. Introduction

In the Idaho white pine region a type commonly occurs which we refer to as "swamp." In these areas, R. petiolare and G. inermis grow in very heavy concentration intermingled with Salix, Alnus, Crataegus and other brush. White pine stands ranging from 25% to 80% are within easy striking distance on the adjacent hillsides, and the nature of the type is such that the damp, moist conditions under which R. petiolare and G. inermis grow, lend themselves to an optimum production and spread of sporidia. Experimental tests show that R. petiolare, possibly next to R. nigrum, is most prolific in the formation of these sporidia. Consequently, from the standpoint of local control, it is necessary to eradicate these areas, and to eradicate them by the most effective and cheapest method.

Experimental work conducted by chemical eradication crews during the years 1925, 1926, 1927 shows that these highly concentrated areas can be more cheaply eradicated by chemicals than by hand. No figures are available on the efficiency of hand pulling this type, but the writer speaks from actual experience when he says that the roots and crowns of large clumps of R. petiolare are extremely difficult, if not impossible to eradicate by hand. When we find R. petiolare in soft, marshy locations, with its roots in many cases under water, and G. inermis intermingled with extremely thick brush; it is easy to appreciate the difficulties of hand pulling. The actual physical labor involved in the use of chemical equipment, is also considerably less than that of hand eradication. This is a very important factor, when one takes into consideration the morale of a crew that is bound to suffer when working over an area of this kind, presenting as it does such adverse working conditions.

It should be observed that Section II of this report covers the field activities which started in eastern California, May 1st and which ended with our field work in Idaho, September 10th. Research work at Berkeley during the winter 1926 and 1927 is fully covered in the first section of the report, and reference to this work should be made in order to understand clearly the course followed by subsequent field experiments.

Early in the year it was decided to keep separate our application studies and our search for new Ribes killers. With this idea in mind the following general working plan was adopted:

1. Rechecking of 1926 work and data taking over the areas worked

last year.

2. Further experimental work with new killing agents in California, and Idaho.

3. Experimental application studies.

a. Eradication of a large area of swamp type using knapsack sprayers and $NaClO_3$ as the killing agent.

b. Testing of power equipment over a relatively large area.

The services of one man in California and one man in Idaho were procured for chemical experimental work and a crew of six men was hired to carry out the large scale spraying operation.

II. (1). Wallace, Idaho - June 2 to 5

The writer, together with L. I. Legrid, commenced work on the Wallace plots June 2. Data were carefully taken to ascertain particularly the condition of R. petiolare the second year after spraying. Results were very encouraging. Only an occasional sprout was found and in most cases it was a difficult task to locate the old roots and crowns. Most of the dead aerial stems had broken off at the surface of the ground and had been washed away by the early season stream floods. No spraying was done at Wallace this year. Data on last year's spraying were also taken.

Table No. 1

Ribes Data - Wallace Plots

Sprayed June, 1926--Data Taken June, 1927

Plot Number	Species	Chemical Used	Con-centra-tion	How Ap-plied	Feet of Live Stem 1927	Feet of Dead Stem 1927	Per cent Kill 1927
I(3.5-3.6)A	R.pet.	$KClO_3$ NaOH	6% 2%	Spray	1 Clump 15'x5'. East of cedar tree.		75 estimated
"	"	$KClO_3$	6%	"	1 Clump 20'x 5'. West of cedar tree.		98 "
I(4-5)A	"	"	"	"	3 large clumps.		93 "
"	R.lac.	"	"	"	2 " "		67 "
II(0-1)A	R.pet.	$KClO_3$	"	"	1 " clump.		98 "
II(1-2)A	"	"	"	"	2 " clumps.		95 "
III(0-1)A	"	NaOH	5%	"	310	300	48.8
"	R.lac.	"	"	"	62	31	33.3
III(1-2)A	R.pet.	"	"	"	2,305	1,202	34.7
"	R.lac.	"	"	"	537	185	25.6

Table No. 2

Recheck of Wallace Plots Sprayed 1925

I(0-4)B	R.pet.	$NaClO_3$	50%	Spray	214	1,131	84.0
"	R.lac.	"	"	"	170	1,006	58.9
I(0-6.6)B	R.pet.	"	25%	"	27	4,440	99.6
"	R.lac.	"	"	"	260	1,031	79.7
I(5-6.6)A	R.pet.	"	"	"	4	489	99.3
"	R.lac.	"	"	"	107	80	42.8
I(0-3.5)A	R.pet.	NaF	5%	"	7,400	981	11.7
"	R.lac.	"	"	"	956	529	35.6

Discussion - One very interesting point arises from the results of 1926 spraying. Note that the strongly alkaline solution of $KClO_3$ is not nearly so effective as the $KClO_3$ alone. This suggests the very interesting problem of the part played by hydrogen and hydroxyl ions.

A recheck of the plots sprayed in 1925 with $NaClO_3$ - 25% showed a kill of 99.4% average. Bushes were completely dead and roots were decayed. The 25% solution was noticeably more active than the 50%.

II.(2) Santa, Idaho - June 6 - 30

Rechecking of the 1926 plots was started by L. I. Legrid and the writer on June 6th. Data were taken on the scheme worked out in previous years and included height of bush, feet of live stem, feet of dead stem and general notes on the condition of the Ribes. These data were taken for each Ribes species present on the ground. For the most part data were taken and recorded by one man. Since the boundaries of the plots were definitely marked, one man could readily work alone by working a scheme of string markers. Two string lines, laid across the 33 feet of a section at distances of 3 feet to 6 feet, depending upon the concentration of Ribes, enabled one to keep careful count of all Ribes. Data are summarized in Table No. 3.

Table No. 3

Ribes Data - Santa Plots
Sprayed July, 1926 -- Data Taken June, 1927

Plot Number	Species	Chemical Used	Concentration	How Applied	Ft. of Live Stem 1927	Ft. of Dead Stem 1927	Per cent Kill 1927
VI(0-1)A	R.lac.	R.B.1	8%	Spray	177	33	15.7
"	G.inerm.	"	"	"	141	21	12.9
VI(1-2)A	R.lac.	NH_4F	4%	"	119	61	33.9
"	G.inerm.	"	"	"	117	70	37.4
VI(2-3)A	R.lac.	NH_4Cl	25%	"	518	1,931	78.7
"	G.inerm.	"	"	"	271	706	72.3
VI(3-4)A	R.lac.	$(NH_4)_2CO_3$	20%	"	717	271	27.4
"	G.inerm.	"	"	"	559	96	14.6
VI(4-5)A	R.lac.	"	15%	"	760	269	26.3
"	G.inerm.	"	"	"	478	69	12.6
VI(5-6)A	R.lac.	NH_4F	10%	"	422	1,268	74.8
"	G.inerm.	"	"	"	542	930	63.2
VI(6-6.6)A	R.lac.	$(NH_4)_2CO_3$	20%	"	1,160	299	20.5
"	G.inerm.	"	"	"	1,410	167	10.6
VI(0-1)B	R.lac.	Via Rasa	8%	"	143	20	12.3
"	G.inerm.	"	"	"	81	12	12.9
VI(1-2)B	R.lac.	NH_4Cl	25%	"	23	55	70.3
"	G.inerm.	"	"	"	55	132	70.7
VI(2-3)B	R.lac.	R.B.1	8%	"	454	126	21.7
"	G.inerm.	"	"	"	215	43	16.7
VI(3-4)B	R.lac.	R.B.11	"	"	273	89	24.6
"	G.inerm.	"	"	"	453	75	14.2
VI(4-5)B	R.lac.	R.B.1	4%	"	1,002	224	18.1
"	G.inerm.	"	"	"	442	87	16.4
VI(5-6)B	R.lac.	R.B.11	"	"	1,862	470	20.1
"	G.inerm.	"	"	"	1,175	285	19.5
VI(6-6.6)B	R.lac.	Via Rasa	6%	"	1,034	191	15.6
"	G.inerm.	"	"	"	847	117	12.3

Table No. 4

X - V	R.lac.	$NaClO_3$	25%	Spray	30	10	25
"	R.pet.	"	"	"	45	1,382	97
X - VIII	R.lac.	NH_4F	5%	"	4	0	0
"	G.inerm	"	"	"	1,127	153	11.9
X - IV	R.lac.	R.B.11	8%	"	501	52	9.4

Table No. 5

Santa Plots

Comparative Results of One or More Applications of One Chemical

Plot Number	Species	Chemical Used	Concentration	How Applied	Times Applied	% Kill 1926	% Kill 1927
I(1-2)A	R.lac.	NaOH	4%	Spray	3	37.8	40.7
"	G.inerm.	"	"	"	3	30.1	39.1
I(2-3)A	R.lac.	"	"	"	2	76	25.3
"	G.inerm.	"	"	"	2	42	32.3
I(0-1)B	R.lac.	$NaClO_3$	25%	"	2	82.7	92.5
"	G.inerm.	"	"	"	2	62.7	91.2
III(2-3)B	G.inerm.	"	"	"	2	42.7	47.2
I(2-3)B	R.lac.	"	18%	"	2	69.1	88.7
"	G.inerm.	"	"	"	2	37.8	57.7
III(0-1)B	R.lac.	"	10%	"	2	62.6	92.7
"	G.inerm.	"	"	"	2	29.5	46.6
II(4-5)A	R.lac.	NH_4Cl	12½%	"	2	30.9	62.2
"	G.inerm.	"	"	"	2	23.8	52.6
III(0-1.5)A	G.inerm.	"	20%	"	2	39.1	32.4
III(2-3)A	G.inerm.	Lvs. strpd. by hand	--	--	2	2.0	34.9
V(0-1)B	R.lac.	$NaClO_3$	10%	Cr. App.	1	50	64.2
"	G.inerm.	"	"	"	1	13.2	54.8
II(6-6.6)B	R.lac.	"	50%	"	1	100	65.0
"	G.inerm.	"	"	"	1	66.6	63.8
II(0-1)B	R.lac.	NaOH	4%	Spray + Soil App.	1	29.0	42.0
II(0-1)B	G.inerm.	"	"	"	1	21.6	29.8

Discussion. Results of 1926 tests of new chemicals on Santa plots do not bring to consideration a more efficient Ribes killer than $NaClO_3$. Ammonium chloride, saturated solution, is probably more effective on G. inermis than $NaClO_3$ in the matter of suppression of live stem. The number of complete kills, however, is less. German weed killers, R.B.I, R.B.II, and Via Rasa were not favorable.

A study of data on plots to which NaOH had been applied two and three times does not indicate that successful methods can be developed by means of a cheap defoliator. Chemical defoliation closely approximates in its action on the bushes, defoliation by hand stripping.

W.678. Santa, Idaho. G. inermis shows sprouting from the crown. 100% kill of original L.S. by means of $NaClO_3$.

W.695. Clarkia, Idaho. White cards indicate R. petiolare seedlings. Germination took place after protecting overstory had been killed with $NaClO_3$.

II. (3) Clarkia, Idaho - June 16 -23

A crew of six men commenced work June 16 over the areas sprayed last year. Ribes data were taken and respraying done on Blocks III, V, and VI. Part of Block III was left unsprayed this year, and half of this section will be sprayed next year. We shall then have comparative experiments on the results of respraying areas in succeeding and alternate years. Table No. 6 compares 1926 and 1927 work.

Table No. 6

Block No.	Chemical Used 1926	Chemical Used 1927	Gals. Spray per A. 1926	Gals. Spray per A. 1927	Man sp.hrs. per A. 1926	Man sp.hrs. per A. 1927	Per cent Initial Cost in 1927	
							Labor	Chemical
III	$NaClO_3$ - 25%	$NaClO_3$ - 25%	110	28.2	22.26	11.2	50.4	25.6
V	$NaClO_3$ - 25% + $CaCl_2$ - 6¼%	" "	72.3	54.5	12.13	9.2	75.8	75.2
VI	$NaClO_3$ - 25% + $CaCl_2$ - 6¼%	" "	67.8	30.2	12.81	8.7	67.9	44.5

In analyzing the data in the above table it is interesting to refer to the following figures which give the efficiency on the different species on these areas:

Table No. 7

Block No.	Species	% Kill 1927	Average Kill	Remarks
III	R.petiolare	96.5		Sprayed in early August.
"	R.lacustre	57.1	64.4	$NaClO_3$ alone - weather
"	G.inermis	39.8		clear and warm.
V	R.petiolare	32.8		Sprayed end of August.
"	R.lacustre	11.7	24.2	$CaCl_2$ added to spray. Weather very unsettled
"	G.inermis	28.1		with rain.
VI	R.petiolare	79.2		As above - only
"	R.lacustre	22.2	42.2	weather clear for most
"	G.inermis	25.2		part.

Last year costs on Block III ran: Chemical, $21.40; labor, $16.47--Total, $37.87. For the respraying work, applying percentages of Table No. 7 we have: Chemical, $5.35; labor, $8.30--Total $13.65.

The second spraying then costs us 25.5% of the original cost. It must be kept in mind that over 95% of this second cost on chemical should be charged against R. lacustre and G. inermis. Experiments performed at Clarkia in 1926 showed that it took about three times as long to actually spray the Ribes as it did to walk over the ground and find them. R. lacustre and G. inermis therefore are responsible for 75% of the labor involved in the second spraying. The cost of respraying the Clarkia area for R. petiolare according to the above estimate is $2.25 per acre.

Table No. 8

Ribes Data - Clarkia Plots

Sprayed August, 1926- Data Taken June, 1927

Block No.	Species	Chemical Used	Concentration	How Applied	Ft. of Live Stem 1927	Ft. of Dead Stem 1927	Per cent Kill 1927
I	R.petiolare	NH_4F + NH_4Cl	(4% (20%	Spray	828	201	19.5
"	G.inermis			"	19,978	3,617	15.6
II	R.petiolare	$KClO_3$	4%	"	11,310	11,888	51.3
"	R.lacustre	"	"	"	492	35	6.6
"	G.inermis	"	"	"	29,596	5,109	14.7
III	R.petiolare	$NaClO_3$	25%	"	982	27,120	96.5
"	R.lacustre	"	"	"	539	717	57.1
"	G.inermis	"	"	"	3,635	2,389	39.8
V	R.petiolare	$NaClO_3$ + $CaCl_2$	(25% (6¼	"	2,343	1,142	32.8
"	R.lacustre			"	697	92	11.7
"	G.inermis			"	6,165	2,410	28.1
VI	R.petiolare			"	3,438	13,045	79.2
"	R.lacustre	"	"	"	910	260	22.2
"	G.inermis			"	15,509	5,209	25.2
VII	R.petiolare			"	9,897	15,928	62.2
"	R.lacustre	"	"	"	746	198	20.9
"	G.inermis			"	13,646	5,601	29.1

Discussion. The best results have been obtained by the use of $NaClO_3$ - 25% and it is interesting to note the consistent figures of 1926 and 1927 work with this chemical:

Table No. 9

viz. -

Species	% Kill on Stem 1926	% Kill on Stem 1927
R.petiolare	96.3	96.5
R.lacustre	57.3	57.1
G.inermis	55.2	39.8

W.676. Clarkia, Idaho. R. petiolare in foreground 1 year after treatment with $NaClO_3$.

W.696. Clarkia, Idaho. Detail of killing procured by $NaClO_3$ sprayed on R. petiolare.

Blocks V, VI, and VII were sprayed much later in the year then Block III and $CaCl_2$ - 6% was added to the spray formulae. Lower percentage of kill is doubtless explained partly by the lateness of the season and partly by the addition of $CaCl_2$. Considerable rain fell during the course of the work on Block V, and no doubt resulted in the loss of considerable chemical, which cut down the kill. The position of R. lacustre and G. inermis in our scale of susceptibility seems to be reversed by the addition of the calcium chloride.

III. (1) Experimental Chemical Work

California

Work was started in California this year for the first time, when the writer sprayed a few R. nevadense in the Stanislaus National Forest near Strawberry early in May. In late July an experimental program was instituted with the location of six permanent plots at Leland Meadow. An area of R. nevadense along the south fork of the Stanislaus just below the dam, was chemically eradicated. As a result of an unfortunate accident to R. P. d'Urbal, who was in charge of the California work, only a start was made on the program. Plots were laid out, data taken and a little spraying completed when the accident happened. However, sufficient spraying has been done to indicate that R. nevadense is rather susceptible to the action of chlorates. A check of 16 R. nevadense sprayed May 7 with $NaClO_3$ - 25% showed 100% kill of live stem in all instances, and only 3 bushes suckering from the crown.

In late September Mr. Benedict checked over the spraying done on R. nevadense along the south fork of the Stanislaus and reported as follows:

(1) New leaves on tips of the bushes in one or two instances.

(2) Crown sprouting from just below the surface of the ground, several cases.

(3) A few missed parts of bushes.

(4) A large percentage of what appears to be completely killed plants.

III. (2) Santa, Idaho

Experimental work for the season 1927 was done by L. I. Legrid with the assistance of the writer. Stations on Plots I to V, established in 1925, and which had not been affected by the chemical applied, were used for the new experiments. This saved considerable time since Ribes data had already been taken over those areas.

Bushes were tagged with white cheesecloth and spraying was done with the three gallon compressed air type of hand sprayer. Stakes, lettered in red on a white background were placed at the northwest corner of each experimental station, following the general scheme used in previous years. Work at Santa covered the period July 1 to September 1.

Santa, Idaho

Legend for Following Spraying Data Sheets

1. Location data.
2. Number of each species.
3. Date, amount, and method of application.
   Cr. App. = crown application.
   sat. = saturated.
4. Chemical used and concentration
5. Soil temperature t_s and relative humidity h_r.
6. Weather

F = Fair	H = Hot
W = Warm	R = Rain
C = Clear	Cd = Cold
Cy. = Cloudy	Wd = Wind
Cl = Cool	T = Thunder
sl = slightly	S = Smoky

7. Remarks

The defoliations marked 9/15/27 are my observations at that time. No frost to cause dropping of leaves had occurred up to that time.

P.B.B.

Santa, Idaho

1. Plot I A (1-2)
2. R. lacustre 56 -- G. inermis 262
3. 7/7/27 16 gals. spray.
4. NaOH 4%
5. t_s 57 h_r 39
6. F.W.C. Heavy dew, Cold nights.
7. Defoliation 100%
   Releaf 40%

1. Plot I A (5-6)
2. R. lacustre 43 -- G. inermis 183
3. 7/9/27 13 gals. spray.
4. $NaClO_3$ 25% NaOH 2%
5. t_s 59 h_r 42

6. F. W. C. heavy dew, cold nights.
7. Defoliation 100%
   Releaf 1% near base of stems.
   Some shoots coming up.
   Stems appear dead.

1. Plot I A (6-6.6)
2. R. lacustre 9 -- G. inermis 153
3. 7/8/27 10 gals. Spray.
4. $NaClO_3$ 25% CH_3COOH 2%
5. t_s 58 h_r 40
6. F.W.C. heavy dew, cold nights.
7. Defoliation 99+%
   Releaf 2%. Shoots coming up.

1. Plot II A (0-1)
2. G. inermis 166
3. 7/11/27 11 gals. Spray.
4. $NaClO_3$ 25% HCl 2%
5. t_s 56 h_r 69
6. Cy. Cl. heavy dew, cool nights.
7. Defoliation 99%
   Releaf 3%. Few shoots coming up.

1. Plot II A (2-3)
2. G. inermis 62
3. 7/5/27 14 gals. Spray.
4. NH_4NO_3 10% $KClO_3$ 5%
5. None given in report for 7/5/27.
6. F.W.C.
7. Defoliation 90%
   Releaf 15%. Kill variable.

1. Plot II A (3-3.7)
2. R. lacustre 2 -- G. inermis 95
3. 7/14/27 9 gals. Spray.
4. $Al_2(SO_4)_3$ 25%
5. t_s 58 h_r 55
6. Cy. Cl. little dew, cool nights.
7. Defoliation 10%
   Releaf 0%. Buds swelling.
   Some branches completely dead.

Santa, Idaho

1. Plot II A (3.7-4)
2. R. lacustre 3 -- G. inermis 51
3. 7/14/27 2 gals. Spray.
4. K_2SO_4 sat.
5. t_s 58 h_r 55
6. Cy. Cl.
7. Defoliation 15% to 20%.
   Releaf 0%

1. Plot II B (0-0.5)
2. R. lacustre 1 -- G. inermis 64
3. 8/6/27 12 gals. Spray.
4. $NaClO_3$ 25%
5. t_s 57 h_r 48
6. F.W.C. cool nights, sl. smoky.
7. Defoliation 100%
   Releaf 15%

1. Plot II A (6-6.6)
2. R. lacustre 1 -- G. inermis 30
3. 7/16/27 2 gals. Spray.
4. $KMnO_4$ 15% HCl 3%
5. t_s 58 h_r 67
6. F.W.C. heavy dew, cold nights.
7. Defoliation 25%
   Defoliation 9/15/27 75%
   Releaf 2%, foliage turned black.

1. Plot II B (0.5-1)
2. R. lacustre 1 -- G. inermis 64
3. 8/6/27 12 gals. Spray.
4. $NaClO_3$ 25% Glue 0.1% as sticker.
5. t_s 57 h_r 48
6. F.W.C., Cl. night, sl. smoky.
7. Defoliation 98 - 100%
   Releaf 25%

1. Plot II B (1-1.5)
2. G. inermis 62
3. 8/6 and 8/27/27 7 gals. Spray.
4. $NaClO_3$ 25% Fish oil soap 1% as sticker
5. t_s 57 and 56 h_r 48 and 39

Santa, Idaho

6. F.W.C., H.
7. Defoliation 99 - 100%
   Releaf 10%

1. Plot II B (1.5-2)
2. G. inermis 65
3. 8/8/ 27 and 12/27 7 gals. Spray.
4. $NaClO_3$ 25% Ca Caseinate 2% as sticker.
5. t_s 56 h_r 39 and 70
6. 8/8/27 F.W.C.H. 8/12 R.Cy.Cl.
7. Defoliation 100%
   Releaf 0%. Stems still alive.

1. Plot II B (2-3)
2. R. lacustre 10 -- G. inermis 146
3. 7/7/ and 8/27 12 gals. Spray.
4. $KClO_3$ 4% CH_3COOH 2%
5. t_s 57 and 58 h_r 39 and 40
6. F.W.C.H. heavy dew, cold nights.
7. Defoliation 75%
   Releaf 2%

1. Plot IIIA (2-3)
2. G. inermis 68 -- R. lacustre 2
3. 7/2 and 7/7 leaves stripped by hand.
4. None
5. t_s 57 h_r 49 and 39
6. F.W.C.
7. Defoliation 100%
   Releaf 70%

1. Plot III A (4-4.2)
2. G. inermis 8
3. 7/18/27 2 gals. Spray.
4. $Na_2Cr_2O_7$ 50%
5. t_s 58 h_r 36
6. F.W.C. heavy dew, cool nights.
7. Defoliation 98%.
   Releaf 10%. Old leaves and stems, turned black. Many stems dead.

Santa, Idaho

1. Plot III A (4.2-4.5)
2. R. lacustre 1 -- G. inermis 20
3. 7/18/27 2 gals. Spray.
4. $Na_2Cr_2O_7$ 25%
5. t_s 58 h_r 36
6. F.W.C. heavy dew, Cl. night.
7. Defoliation 98%
   Releaf 20%. Old leaves and stems turned black. Many stems dead.

1. Plot III A (4.5-5)
2. G. inermis 28
3. 7/19/27 2 gals. Spray.
4. $KMnO_4$ saturated.
5. t_s 58 h_r 34
6. F.W.C. heavy dew, Cd. night.
7. Defoliation 25%
   Defoliation 9/15/27 50%
   Releaf 0%

1. Plot III A (5-5.7)
2. G. inermis 36
3. 7/15/27 3 gals. Spray.
4. $(NH_4)_2S_2O_8$ 25%
5. t_s 56 h_r 49
6. F.W.C. heavy dew, Cl. night.
7. Defoliation 100%
   Releaf 10%. Some plants nearly dead.

1. Plot III A (5.7-6)
2. G. inermis 32
3. 7/15/27 3 gals. Spray.
4. $(NH_4)_2S_2O_8$ 15%
5. t_s 56 h_r 49
6. F.W.C. heavy dew Cl. night.
7. Defoliation 75%
   Releaf 40%. Leaves healthy.

1. Plot III A (6-6.6)
2. G. inermis 9
3. 7/16/27 3 gals. Spray.
4. $Al_2(SO_4)_3$ 20%
5. t_s 58 h_r 67

6. F.W.C. heavy dew, Cl. night
7. Defoliation 1% - 5%
   Releaf 0%

1. Plot III B (3-3.65)
2. R. lacustre 1 -- G. inermis 39
3. 7/19/27 4 gal. Cr. App.
4. $KMnO_4$ sat.
5. t_s 58 h_r 34
6. F.W.C. light dew, Cl. night.
7. Defoliation 1% -5%
   Releaf 0%

1. Plot III B (3.65-4)
2. R. lacustre 2 -- G. inermis 38
3. 7/19/27 4 gals. Cr. App.
4. K_2SO_4 sat.
5. t_s 58 h_r 34
6. F.W.C. heavy dew, Cd. night.
7. Defoliation 1%-5%
   Releaf 0%

1. Plot III B (4-5)
2. R. lacustre 1 -- G. inermis 44
3. 7/19/27 5 gals. Spray.
4. $KMnO_4$ sat.
5. t_s 58 h_r 34
6. F.W.C. heavy dew, Cd. night.
7. Defoliation 1%-5%.
   Defoliation 9/15/27 10 %
   Releaf 0%

1. Plot III B (5-6)
2. G. inermis 72
3. 7/20 and 7/21/27 13 gals. Cr. App.
4. K_2SO_4 sat.
5. t_s 57 h_r 48 and 46
6. F.W.C. heavy dew, Cd. night.
7. Defoliation 1%-5%
   Releaf 0%

Santa, Idaho

1. Plot IV A (0-1)
2. G. inermis 41
3. 7/21/27 4 gals. Spray.
4. $HClO_4$ 4%
5. t_s 57 h_r 46
6. F.W.C. heavy dew, Cd. night.
7. Defoliation 50%
   Releaf 0%

1. Plot IV A (1-2)
2. R. lacustre 1 -- G. inermis 51
3. 7/22/27 4 gals. Spray.
4. HCl 4%
5. t_s 58 h_r 43
6. F.W.C. heavy dew, Cd. nights.
7. Defoliation 75%
   Releaf 0.5%

1. Plot IV A (2-2.35)
2. G. inermis 36
3. 7/22/27 5 gals. Spray.
4. CH_3COOH 8%
5. t_s 58 h_r 43
6. F.W.C. heavy dew, Cd. night.
7. Defoliation 25%-35%
   Releaf 1%

1. Plot IV A (2.35-2.5)
2. G. inermis 16
3. 7/22/27 1½ gals. Spray.
4. CH_3COOH 12%
5. t_s 58 h_r 43
6. F.W.C. heavy dew, Cd. night.
7. Defoliation 40%
   Releaf 0%

1. Plot IV A (2.5-2.7)
2. G. inermis 21
3. 7/23/27 1½ gals. Spray.
4. $NaClO_3$ 25% HCl 2%
5. t_s 58 h_r 43
6. F.W.C.H. heavy dew, Cd. night.
7. Defoliation 100%
   Releaf 10%. Stems still alive.

Santa, Idaho

1. Plot IV A (2.7-3)
2. G. inermis 30
3. 7/26/27 5 gals. Spray.
4. Na_2SO_3 20%
5. t_s 63 h_r 40
6. F.W.C. little dew, sl. Wd. in p.m.
7. Defoliation 10% - 15%
   Releaf 0%

1. Plot IV A (3-4)
2. G. inermis 58
3. 7/26/27 8 gals. Spray.
4. Na_2SO_3 15%
5. t_s 63 h_r 40
6. F.W.C. little dew, sl. Wd. in p.m.
7. Defoliation 10%-15%
   Releaf 0%

1. Plot IV A (4-5)
2. G. inermis 46
3. 7/27/27 6 gals. Spray.
4. Na_2SO_3 15% Ca Caseinate 0.2% as sticker.
5. t_s 59 h_r 38
6. F.W.C.H., little dew, sl. Wd.
7. Defoliation 10%-15%
   Releaf 0%

1. Plot IV A (5-6)
2. G. inermis 45
3. 7/27/27 8 gals. Spray.
4. $KClO_3$ 4% Glycerine 0.5% as sticker.
5. t_s 59 h_r 38
6. F.W.C.H. little dew, sl. Wd.
7. Defoliation 95%
   Releaf 1%. Stems still alive.

1. Plot IV A (6-6.6)
2. R. lacustre 2 -- G. inermis 58
3. 7/28/27 6 gals. Cr. App.
4. Na_2SO_3 15%
5. t_s 58 h_r 20
6. F.W.C. heavy dew, H. in p.m.
7. Defoliation 1% - 5%
   Releaf 0%

Santa, Idaho

1. Plot IV B (0-0.3)
2. G. inermis 24
3. 7/23/27 3½ lbs. Cr. App.
4. CS_2 100%
5. t_s 58 h_r 43
6. F.W.C. heavy dew, cold night.
7. Defoliation 10%
   Releaf 0%

1. Plot IV B (0.3-1)
2. G. inermis 60
3. 7/23/27 6½ lbs. Cr. App.
4. NaOH 2% CS_2 98%
5. t_s 58 h_r 43
6. F.W.C. heavy dew, Cd. night.
7. Defoliation 10%
   Releaf 0%

1. Plot IV B (2-2.2)
2. G. inermis 17
3. 8/23/27 6 gals. Spray.
4. $CH_3C_6H_4OH$ 15%
5. t_s 57 h_r 43
6. Sl.Cy.Cl. R. in a.m.
7. Defoliation 90%
   Releaf 0%

1. Plot IV B (2.2-2.4)
2. G. inermis 18
3. 8/24/27 5 gals. Spray.
4. $CH_3C_6H_4OH$ 25%
5. t_s 56 h_r 66
6. Cy.Cl. T.R. in a.m.
7. Defoliation 95%
   Releaf 0%

1. Plot IV B (2.4-2.65)
2. G. inermis 21
3. 8/25/27 5.gals. Cr. App.
4. $CH_3C_6H_4OH$ 10%
5. t_s 56 h_r 87
6. Cy. Cl. S.
7. Defoliation 10%
   Releaf 0%

Santa, Idaho

1. Plot IV B (2.65-3)
2. G. inermis 32
3. 8/26/27 10 lbs. Cr. App.
4. $C_6H_4Cl_2$ 100%
5. t_s 54 h_r 78
6. S. Cl.
7. Defoliation 1% - 5%
   Releaf 0%. Buds swelling.

1. Plot IV B (3-3.5)
2. G. inermis 15
3. 8/24/27 6 gals. Spray.
4. $C_6H_4Cl_2$ 1% ±
5. t_s 56 h_r 66
6. Cy.Cl. R. in a.m.
7. Defoliation 1% - 5%
   Releaf 0%

1. Plot IV B (3.5-4)
2. G. inermis 16
3. 8/25/27 4 gals. Cr. App.
4. $C_6H_4Cl_2$ 1% ±
5. t_s 56 h_r 87
6. Cy.Cl.S.
7. Defoliation 5%-10%
   Releaf 0%

1. Plot IV B (6-6.1)
2. G. inermis 7
3. 8/26/27 2-4 lbs. Cr. App.
4. $C_6H_4Cl_2$ 100%
5. t_s 54 h_r 78
6. Cl. S. Cd. night.
7. Defoliation 5% - 10%
   Releaf 0%. Leaves all turned red.

1. Plot IV B (6.1-6.5)
2. G. inermis 40
3. 8/26/27 3 gals. Spray.
4. NH_4Cl 25%
5. t_s 54 h_r 78
6. Cl. S. Cold night.
7. Defoliation 75% Defoliation 9/15/27 100%
   Releaf 0%

Santa, Idaho

1. Plot IV B (6.5-6.6)
2. G. inermis 19.
3. 8/26/27 2 gals. Spray.
4. $C_6H_4Cl_2$ 1% ±
5. t_s 54 h_r 78
6. Cl. S. Cd. night.
7. Defoliation 5%
   Releaf 0%

1. Plot V A (0-1)
2. G. inermis 93
3. 8/4 and 8/5/27 12 gals. Spray.
4. $NaClO_3$ 25% NH_4Cl 20%
5. t_s 56 and 57 h_r 51 and 54
6. F.W.C. Cold nights.
7. Defoliation 98%
   Releaf 0%. Stems appear to be dead.

1. Plot V A (1-1.7)
2. G. inermis 61
3. 8/9/27 8 gals. Spray.
4. NH_4Cl 30%
5. t_s 55 h_r 44
6. F.W.C.
7. Defoliation 95%. Releaf 1%
   All on one bush. Stems still alive.

1. Plot V A (1.7-2)
2. G. inermis 25
3. 8/18/27 3 gals. Spray.
4. $NaClO_3$ 25% HCl 1%
5. t_s 55 h_r 51
6. F.W.C. Cold night R. (9)
7. Defoliation 50%. Defoliation 9/15/27 100%
   Releaf 1%

1. Plot V A (2-3)
2. G. inermis 41
3. 8/10/27 11 gals. Spray.
4. $KClO_3$ 4% NH_4Cl 10%
5. t_s 55 h_r 44
6. F.W.C. Cold night, heavy dew.
7. Defoliation 85%. Defoliation 9/15/27 100%
   Releaf 10%

Santa, Idaho

1. Plot V A (3-3.7)
2. G. inermis 52
3. 8/11/27 10 gals. Spray.
4. $KClO_3$ 4% NH_4Cl 5%
5. t_s 56 h_r 51
6. F.W.C. S. Cold night.
7. Defoliation 60-70%. Defoliation 9/15/27 90%
   Releaf 3%

1. Plot V A (3.7-4)
2. G. inermis 18
3. 8/18/27 3.5 gals. Spray.
4. $NaClO_3$ 25% HCl 5%
5. t_s 55 h_r 51
6. F.W.C. Cold night R.(9)
7. Defoliation 60-70%. Defoliation 9/15/27 100%
   Releaf 0.5%

1. Plot V A (4-4.5)
2. G. inermis 23
3. 8/13/27 6 gals. Spray.
4. $NaClO_3$ 25% $MnCl_2$ 0.1%
5. t_s 50 h_r 38
6. F.W.C. Cold night.
7. Defoliation 90%. Defoliation 9/15/27 100%
   Releaf 0%. Stems still alive.

1. Plot V A (4.4-5)
2. G. inermis 22
3. 8/13/27 6 gals. Spray.
4. $NaClO_3$ 25% $MnCl_2$ 0.2%
5. t_s 50 h_r 38
6. F.W.C. Cold night
7. Defoliation 90%. Defoliation 9/15/27 100%
   Releaf 0%. Stems still alive.

1. Plot V A (1.7-2)
2. G. inermis 25
3. 8/18/27 3 gals. Spray.
4. $NaClO_3$ 25% HCl 1%
5. t_s 55 h_r 51
6. F.W.C. Cold night. R. (9)
7. Defoliation 50%. Defoliation 9/15/27 100%
   Releaf 1%

Santa, Idaho

1. Plot V A (2-3)
2. G. inermis 41
3. 8/10/27 11 gals. Spray.
4. $KClO_3$ 4% NH_4Cl 10%
5. t_s 55 h_r 44
6. F.W.C. Cold night, heavy dew.
7. Defoliation 85%. Defoliation 9/15/27 100%
   Releaf 10%

1. Plot V A (3-3.7)
2. G. inermis 52
3. 8/11/27 10 gals. Spray.
4. $KClO_3$ 4% NH_4Cl 5%
5. t_s 56 h_r 51
6. F.W.C. S. Cold night.
7. Defoliation 60-70%. Defoliation 9/15/27 90%
   Releaf 3%

1. Plot V A (3.7-4)
2. G. inermis 18
3. 8/18/27 3.5 gals. Spray.
4. $NaClO_3$ 25% HCl .5%
5. t_s 55 h_r 51
6. F.W.C. Cold night. R. (9)
7. Defoliation 60-70%. Defoliation 9/15/27 100%
   Releaf 0.5%

1. Plot V A (5-5.5)
2. G. inermis 37
3. 8/15/27 6 gals. Spray.
4. $NaClO_3$ 25% $MnCl_2$ 0.5%
5. t_s 56 h_r 51
6. F.W.C. Sl. Cy. in p.m.
7. Defoliation 90%. Defoliation 9/15/27 100%
   Releaf 0%. Stems still alive.

1. Plot V A (5.5-6)
2. G. inermis 38
3. 8/15/27 5 gals. Spray.
4. $NaClO_3$ 25% $MnCl_2$ 1.0%
5. t_s 56 h_r 51
6. F.W.C. Sl.Cy. in p.m.
7. Defoliation 90%. Defoliation 9/15/27 100%
   Releaf 0%. Stems still alive.

Santa, Idaho

1. Plot V A (6-6.6)
2. G. inermis 23
3. 8/16/27 7 gals. Spray.
4. $NaClO_3$ 25% $MnCl_2$ 2.0%
5. t_s 53 h_r 43
6. F.W.C. Wind.
7. Defoliation 85%. Defoliation 9/15/27 100%
   Releaf 0%. Stems still alive.

1. Plot V B (2-2.5)
2. G. inermis 48
3. 8/16 & 8/17/27 9 gals. Spray.
4. $NaClO_3$ 25% NH_4Cl 20% Glycerine 5%
5. t_s 53 and 54 h_r 43 55
6. F.W.C. Wd. 8/17/27 Cl.Cy.Wd.
7. Defoliation 99%.
   Releaf 0%. Stems still alive.

1. Plot V B (2.5-3)
2. G. inermis 40
3. 8/17/27 7.5 gals. Spray.
4. $NaClO_3$ 25% NH_4Cl 20% Glycerine 1%
5. t_s 54 h_r 55
6. Cl.Cy.Wd.
7. Defoliation 99%
   Releaf 0%

1. Plot V B (3.5-4)
2. G. inermis 16
3. 8/19/27 6 gals. Spray.
4. $NaClO_3$ 25% NH_4Cl 20%
5. t_s 54 h_r 52
6. F.W.C. H.in p.m.
7. Defoliation 70%. Defoliation 9/15/27 100%
   Releaf 0%. New growth and some of old growth dead.

1. Plot V B (4-4.5)
2. G. inermis 17
3. 8/19 and 8/20/27 6 gals. Spray.
4. $NaClO_3$ 51% sat.
5. t_s 54 58 h_r 52
6. F.W.C.
7. Defoliation 100%
   Releaf 0%. Stems still alive.

Santa, Idaho

1. Plot V B (4.5-5)
2. G. inermis 15
3. 8/20/27 4 gals. Spray.
4. $ZnCl_2$ 25%
5. t_s 58 h_r 52
6. F.W.C.
7. Defoliation 98%
   Releaf 0%. 1927 growth dead.

1. Plot V B (5-5.5)
2. G. inermis 10
3. 8/20/27 2 gals. Spray.
4. $NaClO_3$ 25% $ZnCl_2$ 15%
5. t_s 58 h_r 52
6. F.W.C.
7. Defoliation 98%
   Releaf 0%. 1 bush undefoliated.

1. Plot V B (5.5-6)
2. G. inermis 18
3. 8/22/27 4 gals. Spray.
4. $KClO_3$ 5% $ZnCl_2$ 25%
5. t_s 54 h_r 43
6. S.Sl.Cy.Cl.
7. Defoliation 100%
   Releaf 0%. Stem still alive.

1. Plot X 7 (S.E.)
2. Not measured.
3. 8/2/27 6 gals. Spray.
4. $KClO_3$ 4% CH_3COOH 1%
5. t_s 59 h_r 52
6. F.W.C.
7. Defoliation 85%. Releaf 0%
   9/15/27--R. petiolare 100% defoliated
   G. inermis 85% "

1. Plot X 1 (W.)
2. Not measured.
3. 8/2/27 2 gals. Spray.
4. K_2SO_4 sat.
5. t_s 59 h_r 52
6. F.W.C.
7. Defoliation 40%. Releaf 2% on terminal buds.
   Other buds swelling.

Table No. 10

July Chemical Application Summary.
Santa, Idaho

Date	Plot	Chemical Used	Concentration	How Applied	Amount Used	Defoliation Days
July 2 and 7	III A (2-3)	Leaves Stripped by Hand.				--
" 5	II A (2-3)	$KClO_3$ NH_4NO_3	5% 10%	Spray	14 gallons	100% 6 days
" 6	II B (2-3)	$KClO_3$ CH_3COOH	5% 1%	"	12 gallons	50% 5 days 20% 12 days
" 7	I A (1-2)	NaOH	4%	Respray	16 gallons	100% 1 day
" 8	I A (6-6.6)	$NaClO_3$ CH_3COOH	25% 1%	Spray	10 gallons	100% 6 days
" 9	I A (5-6)	$NaClO_3$ NaOH	25% 2%	"	13 gallons	100% 4 days
" 11	II A (0-1)	$NaClO_3$ HCl	25% 1%	"	8 gallons	100% 6 days
" 12	See notes	$NaClO_3$	25%	"	¾ gallon	100% 3 days
" 13	" "	$NaClO_3$	25%	"	½ gallon	100% 3 days
" 13	" "	$NaClO_3$	25%	"	¼ gallon	100% 3 days
" 14	II A (3-4)	$Al_2(SO_4)_3$	25%	"	9 gallons	50% 6 days
" 14	Balance of above plot.	K_2SO_4	Saturated Solution	"	2 gallons	50% 6 days
" 15	III A (5-6)	$(NH_4)_2S_2O_8$	25%	"	3 gallons	100% 2 days
" 15	Balance of above plot.	$(NH_4)_2S_2O_8$	15%	"	3 gallons	50% 4 days
" 16	III A (6-6.6)	$Al_2(SO_4)_3$	20%	"	3 gallons	50% 6 days
" 16	II A (6-6.6)	$KMnO_4$ HCl	15% 3%	"	2 gallons	25% 7 days
" 18	III A (4-5)	$Na_2Cr_2O_7$	50%	"	1½ gallons	100% 7 days
" 18	Balance of above plot.	$Na_2Cr_2O_7$	25%	"	2 gallons	75% 7 days
" 19	III B (4-5) III A (4-5) Bal.	HCl $KMnO_4$	3% Saturated	"	6 gallons	15 or 25% 2 weeks
" 19	III B (3-4)	$KMnO_4$	Saturated	Crown Application	4 gallons	10 to 15% 2 weeks
" 19 - 20	III B (5-6) III A (3-4) Bal.	K_2SO_4	Saturated Solution	Crown Application	12 gallons	10 to 15% 2 weeks
" 21	IV A (0-1)	$HClO_4$	4%	Spray	4 gallons	50 to 60% 4 days
" 22	IV A (1-2)	HCl	4%	"	4 gallons	70 to 80% 3 days
" 22	IV A (2.0-2.35)	CH_3COOH	8%	"	5 gallons	40% 3 days
" 22	IV A (2.35-2.5)	CH_3COOH	12%	"	1½ gallons	45 - 60% 3 days
" 23	IV B (0-3)	CS_2	100%	Crown Application	3½ pounds	10 to 20% 7 days
" 23	IV B (0.3-1)	NaOH CS_2	2% 100%	Crown Application	6½ pounds	10 to 15% 7 days
" 23	IV A (2.5-2.7)	$NaClO_3$ HCl	25% 2%	Spray	1½ gallons	70% 7 days
" 26	IV A (2.7-3)	Na_2SO_3	20%	"	5 gallons	10 to 20% 5 days
" 26	IV A (3-4)	Na_2SO_3	15%	"	8 gallons	10 to 15% 5 days
" 27	R. petiolare	Na_2SO_3	15%	"	2 gallons	10% 4 days
" 27	IV A (4-5)	Ca Caseinate Na_2SO_3	2% 15%	"	6 gallons	10% 4 days
" 27	IV A (5-6)	Glycerine $KClO_3$	1% 4%	"	6 gallons	50%
" 28 - 29	IV A (6-6.6)	Na_2SO_3	15%	Crown Application	6 gallons	No defoliation 4 days
" 7	R. petiolare	$KClO_3$ NH_4NO_3	4% 2%	Spray	4 gallons	100% 3 days
" 8	R. petiolare	$NaClO_3$ CH_3COOH	25% 1%	"	2 gallons	100% 4 days
" 9	R. petiolare	$NaClO_3$ NaOH	25% 2%	"	1½ gallons	100% 4 days
" 12	R. petiolare	$NaClO_3$ HCl	25% 2%	"	1½ gallons	100% 4 days

1927 Annual Report
E. R. Offord

Table 11

Daily Soil Temperature, Humidity and Weather Record, Santa, Idaho.

Date	Soil Temperature			Wet and Dry Bulb Difference			Weather Log
	7 a.m.	12 m.	4 p.m.	7 a.m.	12 m.	4 p.m.	
July 1	56	57	58	15°	10.5°	10°	FWC Heavy Dew. Sl wind.
" 2	56	56	59	12	11.5	12.5	FWC
" 3							Rainy
" 4							Rain a.m. FWC p.m.
" 5							FWC
" 6	54	56	60	2	22.5	19.5	FWC Heavy Dew. Cold nights.
" 7	54	56	60	6.5	12	20	FWC Heavy Dew. Cold nights.
" 8	56	57	60	7	14.5	16.5	FWC Heavy Dew, Cold nights, sl wind p.m.
" 9	58	59	60	7.5	--	15	FWC Heavy Dew, Cold nights.
" 10	52	58	58	6	14	8.5	" " " " "
" 11	54	57	58	4	7	5.5	Cloudy, cool. Heavy dew, cool night.
" 12	57	60	62	4.5	7.5	17	FWC Rain p.m. Also during night.
" 13	56	58	61	6.5	11	14	Cloudy, warm, heavy dew.
" 14	55	57	62	4	10	9.5	Cloudy, cool, little dew. Cool night.
" 15	54	55	60	5	12	12	FWC Cool night, heavy dew.
" 16	56	58	60	5	5	8	FWC heavy dew, cool night. Fog a.m.
" 17	56	58	64	4.5	9.5	9	FWC heavy dew, cool night.
" 18	56	58	61	13	9	26	FWC heavy dew, cool night.
" 19	55	58	60	15	23	14	FWC. Hot p.m. Heavy dew, cold night.
" 20	54	57	60	15	12.5	13	FWC, heavy dew, cold night, hot p.m.
" 21	53	56	61	11	11	15	FWC, heavy dew, cold night, hot p.m.
" 22	54	58	62	13	11.5	17	FWC, heavy dew, cold night, very hot p.m.
" 23	54	57	63	13	11.5	17	FWC, heavy dew, cold night, very hot p.m.
" 24	56	59	63	16	14	18	FWC, heavy dew. Cold night. Hottest day.
" 25	53	62	66	13	21.5	28.5	Rainy a.m., FWC p.m.
" 26	60	62	66	20	16	15	FWC, very little wind and dew.
" 27	57	60	61	15	17	16	FWC, hot p.m. Slight wind p.m.
" 28	56	59	60	19	30	29	FWC, hot p.m. Heavy dew.
" 29	56	58	60	13	20	13	FWC, hot p.m. Heavy dew.
" 30	56	58	60	16	12	15	WFC, hot p.m. Very little dew.
" 31	57	58	62	12	4	3	FWC, cloudy p.m. Hot.

Legend: F--Fair; W--Warm; C--Clear.

Table No. 12

August Chemical Application Summary, Santa, Idaho

Date	Location	Chemical	Concentration	Method of Application	Amount	Defoliation in Days
August 2	S.E. X 7	$KClO_3$ CH_3COOH	4% 1%	Spray	6 gallons	85% 7 days
" 2	W. X 1	K_2SO_4	Saturated	"	2 gallons	40% 10 days
" 3	R. petiolare	K_2SO_4	"	Crown Application	2 gallons	20% 14 days
" 4 & 5	V A (0-1)	$NaClO_3$ NH_4Cl	25% 20%	Spray	12 gallons	98% 5 days
" 5	II B (0-.5)	$NaClO_3$	25%	"	11 gallons	90% 6 days
" 6	II B (.5-1)	$NaClO_3$ Glue	25% 0.1%	"	12 gallons	98% 6 days
" 6 & 8	II B (1-1.5)	$NaClO_3$ Fish Oil Soap	25% 1.0%	"	7 gallons	95% 7 days
" 8	II B (1.5-2)	$NaClO_3$ Ca Casienate	25% 2%	"	7 gallons	98% 7 days
" 9	V A (1-1.7)	NH_4Cl	30%	"	8 gallons	95% 6 days
" 10	V A (2-3)	$KClO_3$ NH_4Cl	4% 10%	"	11 gallons	85% 5 days
" 11	V A (3-3.7)	$KClO_3$ NH_4Cl	4% 5%	"	10 gallons	60 - 70% 4 days
" 13	V A (4-4.5)	$NaClO_3$ $MnCl_2$	25% 0.1%	"	6 gallons	90% 6 days
" 13	V A (4.5-5)	$NaClO_3$ $MnCl_2$	25% 0.2%	"	6 gallons	90% 7 days
" 15	V A (5-5.5)	$NaClO_3$ $MnCl_2$	25% 0.5%	"	6 gallons	90% 7 days
" 15	V A (5.5-6)	$NaClO_3$ $MnCl_2$	25% 1.0%	"	5 gallons	90% 7 days
" 16	V A (6-6.6)	$NaClO_3$ $MnCl_2$	25% 2%	"	7 gallons	85% 6 days
" 16 & 17	V B (2-2.5)	$NaClO_3$ Glycerine NH_4Cl	25% 5% 20%	"	9 gallons	99% 5 days
" 17	V B (2.5-3)	$NaClO_3$ NH_4Cl Glycerine	25% 20% 1%	"	7.5 gallons	99% 5 days
" 18	V A (1.7-2)	$NaClO_3$ HCl	25% 1%	"	3 gallons	50% 4 days
" 18	V A (3.7-4)	$NaClO_3$ HCl	25% .5%	"	3.5 gallons	60-70% 4 days
" 19	V B (3.5-4)	$NaClO_3$ NH_4Cl	25% 20%	"	6 gallons	70% 3 days
" 19 & 20	V B (4-4.5)	$NaClO_3$	51%	"	6 gallons	100% 9 days
" 20	V B (4.5-5)	$ZnCl_2$	25%	"	4 gallons	98% 8 days
" 20	V B (5-5.5)	$NaClO_3$ $ZnCl_2$	25% 15%	"	2 gallons	98% 8 days
" 22	V B (5.5-6)	$KClO_3$ $ZnCl_2$	5% 25%	"	4 gallons	100% 7 days
" 23	IV B (2-2.2)	$CH_3C_6H_4OH$	15%	"	6 gallons	95% 7 days
" 24	IV B (2.2-2.4)	$CH_3C_6H_4OH$	25%	"	5 gallons	95% 5 days
" 24	IV B (3-3.5)	$C_6H_4Cl_2$	1%	"	6 gallons	5-10% 4 days
" 25	IV B (2.4-2.65)	$CH_3C_6H_4OH$	10%	Crown Application	5 gallons	10% 4 days
" 25	IV B (3.5-4)	$C_6H_4Cl_2$	Saturated	Crown Application	4 gallons	5% 4 days
" 24	V B (6-6.6)	K_2SO_4	Dry	Crown Application	5-6 pounds	5-10% 3 days
" 26	IV B (2.65-3)	$C_6H_4Cl_2$	Dry	Crown Application	10 - 12 pounds	5-10% 3 days
" 26	IV B (6-6.1)	$C_6H_4Cl_2$	Dry	Crown Application		5-10% 3 days
" 26	IV B (6.1-6.5)	NH_4Cl	25%	Spray	3 gallons	75% 3 days
" 26	IV B (6.5-6.6)	$C_6H_4Cl_2$	Saturated Solution	"	2 gallons	5% 3 days

Table No. 13

Daily Soil Temperature, Humidity and Weather Record, Santa, Idaho.

Date	Soil Temperature			Wet and Dry Bulb Difference			Weather Log
	7.a.m.	12 m.	4 p.m.	7 a.m.	12 m.	4 p.m.	
August 1	56	58	62	6	17	5	F.W. Sl. Cy. Sl. R.
" 2	56	59	62	6	15	7	F.W.C.
" 3	55	58	62	6	8	4	F.W.C. Hot in p.m.
" 4	53	55	60	4	19	4	F.W.C. Cold night
" 5	54	58	60	10	8	13	F.W.C. Cold night.
" 6	53	57	61	3	10	15	F.W.C. Cold night.
" 7	54	57	60	12	12	12	F.W.C. Cold night.
" 8	54	57	58	80	17	15	F.W.C. Cold night.
" 9	52	55	58	6	16	12	F.W.C. Cold night.
" 10	50	55	60	8	17	11	F.W.C. Heavy dew.
" 11	52	57	60	17	11	12	F.W.C. Smoky.
" 12	54	56	58	1	6	6	R. Cl. Cy.
" 13	47	48	54	6	13	19.5	F.W.C. Cold night.
" 14	--	--	St.	Maries	--	--	--
" 15	54	56	59	5	12	11	F.W.C. Sl. Cy.
" 16	50	52	57	7	15	14	F.W.C. Wind
" 17	50	54	58	8	11	9	Cy.Cl.Wd.
" 18	52	55	59	3	8	15	F.W.C. Cold night. Rain a.m.
" 19	50	54	58	6	12	10	F.W.C. Hot in p.m.
" 20	55	58	60	6	11	11	F.W.C.
" 21	55 (10 a.m)		60	13	--	2	F.W.C. Smoky.
" 22	50	54	57	6	21	8	S. Sl.Cy. Cl.
" 23	54	57	60	8	15	14	Cl. Cy. Rain in am.
" 24	54	55	58	4.5	6	8	Cl. Cy.
" 25	49	52	56	1.5	0.5	4	Cl. Cy. Cold night.
" 26	52	54	55	2.5	7	1	Smoky Cl.
" 27	50	53	57	1.0	4	7	R. Cl.
" 28	50	--	60	2	--	2	Sl. Cy.
" 29	54	56	56	1	2	2	F.W.C. Rain in p.m.
" 30	47	54	58	1	4	2	Foggy. Cy.Cl.

Legend: F--Fair; W--Warm; C--Clear; Sl.--Slightly; Cy.--Cloudy; R.--Rain; H--Hot; S--Smoky; Cl.--Cool

Discussion. Seventy-three spray formulae were tested as Ribes killers. A summary of this work appears in the preceding tables. Early observations point to some interesting results from a formula $NaClO_3$ - 25% + NH_4Cl - 10%. Ammonium persulphate also looks favorable. Addition of 1 to 2% of a strong or weak acid to $NaClO_3$ seems to have the same inhibiting effect as did the addition of a strong or weak base. A more careful adjustment of the P_H value by means of a hydrolysed salt such as NH_4Cl will probably be more effective. Chlorate sprays to which were added (0.1 to 2.0%) $MnCl_2$ (Note: Mn promotes oxidation in life processes of plants) look favorable to date but are rather too recent experiments to be indicative of final results. Final data on these plots will be taken in the spring of 1928.

IV. (1). Bovill, Idaho, June 23-August 15

This area represented similar working conditions to those encountered at Clarkia, Idaho. The area contained R. petiolare, G. inermis and R. lacustre mixed with very heavy stream bottom brush.

The east fork of Potlatch Creek was traversed and mapped over two miles of its length starting at Frye Meadow and ending at old Winton Camp. The area was divided into eight blocks and Ribes data were taken every quarter mile (by a crew of six men, five men in line and a recorder) on a strip 1/2 chain wide and then applied over the acreage on that particular block.

Table No. 14 gives the complete Ribes data.

Table No. 14

Ribes Data, Bovill, Idaho

Block	Strip	Area in Acres	R. petiolare		R. lacustre		G.inermis		R. visco.	
			Live Stem	Dead Stem	Live Stem	Dead Stem	Live Stem	Dead Stem	Live Stem	Dead Stem
I	1 & 2	1.59	2,289	20	2,450	5	776	0	0	0
I		Stem per Acre	1,441	12.5	1,540	3.2	448	0	0	0
II	1 & 2	.83	1,977	0	887	0	3,425	0	0	0
II		Stem per Acre	2,382	0	1,068	0	4,130	0	0	0
II	Total	17.185	96,589	341	21,145	10	56,987	0	230	0
III	1 & 2	.62	7,410	0	470	0	899	5	0	0
III		Stem per Acre	11,950	0	757	0	1,448	8.3	0	0
III	Total	13.235	129,417	213	22,721	0	50,955	12	237	0
IV	1 & 2	1.14	8,049	0	407	0	9,300	10	274	5
IV		Stem per Acre	7,049	0	356	0	8,150	8.8	240	4.4
V	1 & 2	1.10	634	0	1,444	0	328	0	0	0
V		Stem per Acre	576	0	1,314	0	298	0	0	0
VI	1 & 2	.67	2,406	0	966	0	1,013	0	45	0
VI		Stem per Acre	3,595	0	1,442	0	1,515	0	67	0
VII	1 & 2	.70	4,250	2	188	0	237	0	10	0
VII		Stem per Acre	6,070	2.9	269	0	339	0	14.3	0
VIII	1 & 2	1.320	4,123	0	1,969	0	1,140	0	5	0
VIII		Stem per Acre	3,170	0	1,512	0	878	0	3.9	0

Feet of stem per acre was calculated in every block from the two five-chain strips at beginning of each block.

Blocks I, II, and III were later reworked for Ribes data on the basis of a complete cruise. The following data which compare the two methods are rather interesting and are about as inconsistent as one would expect:

Table No. 15

Block No.	R. petiolare		R. lacustre		G. inermis	
	Live Stem per Acre 0.5-chain Strip	Live Stem per Acre Complete Cruise	Live Stem per Acre 0.5-chain Strip	Live Stem per Acre Complete Cruise	Live Stem per Acre 0.5-Chain Strip	Live Stem per Acre Complete Cruise
I	1,441	5,040	1,540	1,518	448	6,485
II	2,382	5,650	1,068	1,230	4,130	3,320
III	11,950	9,775	757	1,715	1,448	3,850

Comparison of Live Stem figures for G. inermis on Block I illustrates the error which can easily be made by the strip method when the line is run through extremely dense brush. Ribes can be present in heavy concentration a few feet off the line and are never seen by the crew men or recorder.

Large scale spraying operations at Bovill, Idaho, were carried out by a six-man crew with P. B. Bell in charge. Details of the work are fully covered in a special report on crew management by Bell. A summary of the spraying work is given below.

Table No. 16

Block	Section	Chemical	Acres	Gallons	Man Spraying Hours
I	1	$NaClO_3$ 25%	9.155	588.5	177.2 hours
I	2	$NaClO_3$ 25% Whale oil soap.1%	6.105	370.5	111.2 hours
II	1	$NaClO_3$ 25% Glue .03%	5.435	353.5	91.1 hours
II	2	$NaClO_3$ 20%	6.875	425.5	103.2 hours
Total			27.57	1,738.0	482.7 hours

Block	Section	Actual Spraying Days
I	1	9
I	2	5
II	1	4
II	2	6

After a number of days of crew spraying, it was thought advisable to recheck the sprayed areas and take data on missed Ribes. The following table drawn up by P. B. Bell shows the nature and location of missed bushes:

Table No. 17

Rechecking Data on Block I, Bovill, Idaho.

Species	No. of Plants Not Completely Sprayed	Acres Sprayed	Spray Symbol	Section	Ft. of Undefoliated System	% of Defoliation	Portion of Plant not Completely Sprayed				Location of Missed Ribes				Crew Efficiency
							End of Stem	Whole Branch or Stem	Half Stem or Branch	Complete Miss	Open	Low Under Brush	High In Brush	Under Windfall	
R.pet.	22	9.155	I	1	158	99.73	9.1	77.2	9.1	Not taken sep.sect.1	27.3	5.9	0	0	
G.inerm.	58	"	I	1	153.5	99.73	37.3	53.5	6.9	"	27.6	57.7	6.9	1.7	
R.lac.	14	"	I	1	36	99.67	14.3	85.8	0	"	28.6	64.2	0	7.1	
R.pet.	6	6.105	II	2	20	99.82	0	0	16.6	100	33.3	50	0	0	98%
G.inerm.	84	"	II	2	281	97.69	60.7	3.6	3.6	34.6	19	72.6	6	1.2	91%
R.lac.	48	"	II	2	169	99.6	12.5	4.2	10.4	68.8	43.8	48	0	8.3	85%
R.visc.	0	"	II	2	0	100.00	0	0	0	0	0	0	0	0	100%

On August 15th the crew started experimental work with power equipment at Clarkia, Idaho.

Several days were spent in trying out various combinations of hose lines and volume discharge and pressure tests were made using hose lengths varying from 50' to 700'. Location and set-up of the pumper, length of hose lines, handling of lines over areas, relative lengths of main line and laterals, hose couplings, number of spraying nozzles, ground to be covered by each spray line, handling chemical, making up solutions and keeping the solutions in the supply reservoirs, moving equipment from one set-up to another and combinations of two or more pumpers for spraying and relaying chemical, were among the salient points worked over and discussed.

The present working plan seems to lend itself to a seven-man crew, whose duties are divided up as follows: A foreman who blocks out the areas, selects the set-ups for the pumper, lays the main hose line with its attached "T" and keeps the hose lines of the men straightened out, a mechanic who runs the engine and keeps a constant supply of solution in the spraying tanks; five crew men in line, one of whom acts as an assistant foreman and is directly responsible for the efficiency of the men at work on the nozzles. The assistant foreman and the mechanic are responsible for the movement of all equipment.

Blocks I and II were worked over in crew formation (6 ft. between each man) and the data on gallons of solution used, man spraying hours, man hours, handling of equipment were compared with that data obtained last year when the same blocks were eradicated by hand sprayers. Comparative data are as follows:

Block I		Hand Spraying
Spraying time	-	47 hrs. 42 mins.
Gallons sprayed	-	98 hrs.
Acreage	-	4.17

Block I		Power Spraying--Pacific Pumper
Spraying time	-	16 hrs. 24 mins.
Handling equipment	-	14 hrs. 12 mins.
Gallons sprayed		109
		Ross Pumper
Spraying time	-	12 hrs. 2 mins.
Handling equipment	-	13 hrs. 54 mins.
Gallons sprayed	-	105

Block II		Hand Spraying
Spraying time	-	66 hrs. 36 mins.
Gallons Sprayed	-	224
Acreage	-	1-1/2

Block II		Power Spraying--Ross Pumper
Spraying time	-	23 hrs. 44 mins.
Handling equipment	-	19 hrs. 32 mins.
Gallons Sprayed		216
		Pacific Pumper
Spraying time	-	19 hrs. 0 mins.
Handling equipment	-	11 hrs. 36 mins*
Gallons sprayed	-	152**

*Cut out one set-up by hose management.
**Brush very wet during first part of spraying.

After working with the two pumpers, Ross and Pacific, it is evident that neither one exactly meets our requirements. The light weight of the Pacific Pumper is a decided advantage, but the finer atomization of the spray obtained by working at higher pressures with the Ross Pumper is also desirable. The work so far has been very encouraging and indicates that a decided saving can be affected by means of power equipment, although it seems certain that hand spraying will always have to be considered as an integral part of our most efficient scheme of chemical eradication. Outlying sections of our swamp type where the Ribes occur in lower concentration and somewhat scattered can be more economically eradicated by means of the more mobile hand spraying crew.

A detailed report and analysis of data on power spraying are given in a special report on crew management by P. B. Bell.

Table No. 18

Total Costs Chemical Eradication Work
June 1 - - September 10.

Item	Crew Work Bovill & Clarkia	Experimental Work. Santa	Experimental Work Stanislaus Forest	Total
Payroll	$1,518.42	$ 646.67	$ 156.67	$2,321.76
Subsistence and Transportation	938.60	312.08	174.26	1,424.94
Equipment 1927 and 1926 & 1925 Charge	152.33	60.93	30.47	243.73
Repairs, Hauling and Freight	32.43	12.97	6.49	51.89
Chemical	281.54	201.34	58.49	541.37
Power Sprayer	786.00			786.00
Totals	$3,709.32	$1,233.99	$426.38	$5,369.69

Total Man Hours Field Work = 5,096 Cost per Man Hour = $1.05

Cost of Experimental Work at Berkeley - October, 1926 to June, 1927.

Payroll	$1,136.76
Subsistence and Transportation	75.00
Chemical and special Apparatus	90.23
	$1,201.99

Table No. 19

Chemical Eradication Costs Crew Work - Bovill, Idaho.

Chemical	Total Ribes Live Stem per Acre	Block No.	Acre-age	Man Spraying Hours		Gallons of Chemical		Chemical Cost		Labor Cost		Total Cost*	
				per Acre	per 1000' L.S.	per Acre	per 1000' L.S.	per Acre	per 1000' L.S.	per Acre	per 1000' L. S.	per Acre	per 1000' L. S.
$NaClO_3$ - 25%	9,100	I	22.3	17.7	1.90	62.1	6.82	11.80	1.29	9.02	0.99	$20.82	$2.28
$NaClO_3$ - 20%	11,490	II	6.9	14.8	1.30	61.7	5.37	9.38	0.82	7.54	0.66	$16.92	$1.48

*Above costs are for a six-man crew. Chemical cost 19¢ a gallon for $NaClO_3$ - 25% and 15.2¢ - 20%. Labor cost 51¢ per man spraying hour.

Comparison of Chemical Eradication Costs

	1925	1926	1927
Average per Acre	$59.10	$27.41	$20.82) for $NaClO_3$ - 25% $16.92) " " - 20%

Summary of Work Done

(1). During the seasons of 1924 and 1925 three one-acre plots at Wallace, Idaho, and five one-acre plots at Santa, Idaho, were staked out. Data which were taken included height of Ribes bush, feet of live stem and feet of dead stem per bush. A crew of five men carried out the work on these areas. Chemicals were applied (1) as a spray (2) in solid form about the roots and crown (3) in saturated solution squirted on the soil at the base of the plant. A three-gallon hand-compressed sprayer was used and found to be satisfactory for the open type of country encountered.

(2). During the 1926 season data were carefully taken over all plots. New chemicals were tested on an additional one-acre area at Santa and fifteen acres of R. petiolare and G. inermis were eradicated. This latter work was done at Clarkia, Idaho, and special studies were made of equipment and crew working methods. A four-gallon knapsack sprayer was found to be most satisfactory for general crew work.

(3). Experimental work with new chemicals and crew spraying work were kept separate during the 1927 field season. Experimental work was carried out at Santa, Idaho, while a large area of R. petiolare, G. inermis has been eradicated at Bovill, Idaho, according to our best working methods.

The following is a list of chemicals tested, giving name, formulae, concentration and comment on their effectiveness:

Table No. 20

Observations of Chemical Action on Ribes

Name	Formulae	Concentration	Remarks
Oxalic acid	$(COOH)_2$	10%	Indeterminate. Has possibilities.
Manganese sulphate	$MnSO_4$	25%	Unfavorable.
Magnesium sul hate	$MgSO_4$	20%	"
Zinc sulphate	$ZnSO_4$	15%	"
Iron sulphate	$Fe_2(SO_4)_3$	10%	Indeterminate.
Calcium hypochlorite	$Ca(OCl)_2$	Solid	"
Calcium cyanide	$Ca(Cn)_2$	"	"
Copper sulphate	$CuSO_4$	10-15%	Unfavorable.
Mercuric chloride	$HgCl_2$	1-2-5%	"
Lead acetate	$Pb(C_2H_3O_2)_2$	25%	"
Potassium ferrocyanide	$K_4Fe(CN)_6$	10-15%	"
Potassium cyanide	KCN	15%	Indeterminate.
Chromic acid	H_2CrO_4	10%	Unfavorable.
Phenol	C_6H_5OH	5-10%	"
Tannic acid	$C_{14}H_{10}O_9$	10%	"
Sodium chlorate	$NaClO_3$	25%	Favorable. This solution has been used with the following spreaders: Fish Oil Soap 0.1% (best). Glue 0.1%. Linseed Oil 1%. Calcium caseinate 2%.
Sodium chlorate and calcium chloride	$NaClO_3$ $CaCl_2$	25% 6¼%	Favorable. Not quite as good as $NaClO_3$ alone.
Sodium chlorate and sodium hydroxide	$NaClO_3$ NaOH	25% 2%	Favorable. Not as good as $NaClO_3$.
Sodium chlorate and acetic acid	$NaClO_3$ $C_2H_4O_2$	25% 2%	Indeterminate. Applied this year.
Sodium chlorate and ammonium chloride	$NaClO_3$ NH_4Cl	25% 20%	" " " "
Potassium chlorate	$KClO_3$	5% 25%	Favorable. Not as effective as $NaClO_3$.
Sodium chloride	NaCl	Also solid	Unfavorable.
Sodium bromide	NaBr	15%	"
Sodium fluoride	NaF	4%	Indeterminate.
Sodium tetraborate	$Na_2B_4O_7$	10%	Unfavorable.
Ammonium chloride	NH_4Cl	25%	Favorable. Probably our best on G.inermis.
Ammonium carbonate	$(NH_4)_2CO_3$	20%	Unfavorable.
Ammonium dischromate	$(NH_4)_2Cr_2O_7$	2%	Indeterminate.
Ammonium bromide	NH_4Br	10%	"
Ammonium fluoride	NH_4F	8-10%	Favorable.
Ammonium nitrate	NH_4NO_3	10-15%	Unfavorable.
Ammonium persulphate	$NH_4S_2O_8$	15-25%	Favorable. Action like $NaClO_3$
Potassium fluoride	KF	4%	Indeterminate.
Calcium chloride	$CaCl_2$	5-10-20%	Unfavorable.
Barium chloride	$BaCl_2$	10%	"
Sodium hydroxide	NaOH	2-4%	"
Kerosene	---	100%	Favorable.
Ferrous oxide	FeO	3%	Unfavorable.
Sodium dischromate	$Na_2Cr_2O_7$	15%	Indeterminate.
Zinc chloride	$ZnCl_2$	10%	"
Aluminium sulphate	$Al_2(SO_4)_3$		"
Sodium fluoride and sodium hydroxide	NaF NaOH	4% 2%	Unfavorable.
Perchloric acid	$HClO_4$	1-2%	Indeterminate

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Our best working unit so far is a crew of six men consisting of (a) a foreman who runs in string lines and blocks out the work ahead of the crew, makes up spray solutions and keeps chemical and equipment up with the crew and whenever possible checks behind the crew, (b) an assistant foreman who works right in the crew line and who supervises most of the actual spraying, (c) four crewmen who carry the heavy part of the spraying job.

The best results to date from these experiments have been obtained by the use of a spray solution of sodium chlorate, $NaClO_3$, 25% by weight, which killed 96.3% of R. petiolare.

Fish oil soap (0.1% of the dry weight of $NaClO_3$ used) was found to be the most satisfactory sticker. Sodium chlorate spray after drying on the foliage is highly inflammable. Addition of calcium chloride or ammonium chloride (25% of the dry weight of $NaClO_3$ used,) reduces the inflammability hazard somewhat but partially destroys the effectiveness of $NaClO_3$ as a Ribes killer. Further consideration of this important point is being given.

Field and laboratory experimental work is incomplete but results appear to indicate:-

Concluded from Field Experiments

(1) that, R. petiolare can be killed by one application of the spray to the aerial parts.

(2) that, Ribes of moist habitat are more susceptible than Ribes of dry situation, but a marked difference in susceptibility to $NaClO_3$ occurs between R. petiolare and G. inermis which are both of damp habitat.

(3) that, best results are obtained by applying chemicals early in the growing season. A period of warm dry weather with a slight fall of dew in the evening and early morning seems to provide ideal conditions for the action of the chemical.

Concluded from Laboratory Experiments.

(4) that, absorption of the chlorate, if any, is small in magnitude and probably local in nature.

(5) that, the amount of halogen present in Ribes tissue after treatment with $NaClO_3$ is greatest under optimum conditions of moisture and light. This also holds good for the $KBrO_3$.

(6) that, no increase is observed in the halogen content of the

roots after application of chlorate to the aerial parts of Ribes.

(7) that, the action of $NaClO_3$ is much faster on Ribes placed outside in full sunlight than on greenhouse plants where a partial exclusion of the ultra-violet end of the spectrum occurs.

(8) that, the action of $NaClO_3$ is much greater on plant tissue when the Ribes are kept so that all cells are in a turgid condition.

(9) that, action is more rapid when the chlorate is applied to the lower leaf-surface than when it is applied to the upper surface.

(10) that, the toxic action of sodium chlorate is due to the liberation of nascent oxygen under ultra-violet action of the sun.

R. petiolare is being eradicated in Idaho with this chemical by crews of men provided with four-gallon knapsack sprayers. It is planned to take over most of this work with small portable power sprayers which have been built and which are now being tested out. See report of P. B. Bell for details of crew management with hand sprayers and power sprayers.

Results on R. petiolare are very encouraging and we can now state that R. petiolare can be more cheaply and effectively eradicated by means of sodium chlorate than by hand pulling methods. G. inermis still presents a problem, but a fundamental understanding of the action of sodium chlorate on R. petiolare will doubtless help us in solving the G. inermis difficulty. It is expected that with the development of power spraying methods, will come a material decrease in our costs per acre, which costs at present represent a definite saving over hand eradication for very heavily concentrated areas.

Section III

CHEMICAL ERADICATION CREW MANAGEMENT

By
Percy B. Bell,
Agent.

A. Working Plan Used on Bovill, Idaho Area

I. Equipment Used:

(a) Sprayer used was the D. B. Smith and Company knapsack sprayer, consisting of a 5-gallon tank with a curve to fit the back, a "Sturdy Pump" fitted with a No. 3 nozzle and a rubber hose to connect pump to tank. (See D. B. Smith & Company Catalog No. 40).

(b) Other equipment consisted of three 15-gallon boilers or tubs, large wooden paddles for mixing solution, tin funnels, gallon measures, and general camp equipment.

II. Spray Used:

(a) Block I, section 1, $NaClO_3$ 25%

(b) Block I, section 2, $NaClO_3$ 25% + whale oil soap 0.1%

(c) Block II, section 1, $NaClO_3$ 25% + Glue 0.1%

(d) Block II, section 2, $NaClO_3$ 20%

III. Personnel of Unit:

(a) Foreman who was in complete charge of unit.

(b) Assistant foreman who was appointed each day by the foreman since all crew men were inexperienced. He was one of the spraying crew and did the same work as other members of the crew except that he was responsible for the actions of the crew that day during times when the foreman was absent.

(c) Four crew men who with the assistant foreman did the actual spraying. (This six-man unit was found to be the most efficient crew for knapsack spraying.)

IV. Laying out Area for Spraying:

(a) Blocking off and mapping. The area chosen was on the East Fork of Potlatch Creek from Frye Meadow to Winton Logging Camp No. 4, (camp now abandoned).

W.115. Bovill, Idaho. Alluvial valley at mouth of Robs Creek. Note R. petiolare along sides of stream.

W.679. Bovill, Idaho. Upper end of Block 2, Chemical Erad. plots. Note concentration of brush. Typical of alluvial bottom land that must be worked by chemical methods.

The area was blocked off in 1/4 mile blocks by compass strips beginning at an old log shed at head of Frye Meadow and ending near Winton Camp. A traverse map of this area was made. (See maps enclosed with this report).

(b) When ready to begin actual spraying, parallel strips in the majority of cases were laid out approximately at right angles to the drainage by the foreman. These strips were .5 chains wide and marked by means of string lines. By pacing the length of each strip was determined from which the acreage was computed and recorded.

In some cases it was found to be more convenient to lay out strips parallel to the drainage. This was especially true when the creek came quite close to the boundary lines or roads from which the work was being done.

V. Handling Unit over Area:

(a) Preliminary preparations. While the parallel strips were being laid out, the crew prepared solution for spraying, repaired any defective equipment, and made any other adjustments necessary for actual spraying.

The solution necessarily had to be made up near the creek, consequently spraying on the strips was begun at the creek.

(b) The tanks were filled with solution by means of a gallon measure and a funnel. In this way, the solution was measured as the tanks were filled. The solution was all strained through a double thickness of cheesecloth during this same process.

(c) Spraying was done with a five-man crew moving abreast taking the width of one strip (.5 chain). Thus each man was responsible for a strip less than seven feet wide or three and one half feet on each side of him. With this width of a strip he could thoroughly spray each leaf and stem of the Ribes bushes of his area.

If the concentration of Ribes and length of strip allowed, the crew tried to make one complete round (two strips) before refilling tanks. Otherwise the crew sprayed until their solution was nearly gone. On leaving a strip to refill, they generally stopped spraying at a place which formed a natural boundary so that they did not miss any Ribes when they returned.

If, due to varying concentrations of Ribes on different parts of the strip being sprayed, one man ran out of spray before the rest, the other men would each take a little wider strip and go a little slower in order

to cover the whole width of the strip. This enabled the spraying line to keep moving forward while he returned to the filling station to get more solution.

If two or more men ran out of solution before the rest, it was found preferable to have the whole crew return and refill, or for those not out of solution to remain where they were until the rest returned. In this way, there was no misunderstanding as to which bushes had been sprayed and which had not.

In spraying it was found best to keep very nearly a straight line formation even at the cost of one man having to be idle while waiting for the rest to catch up. For if one man left his place to help someone else in his territory, the one being helped often would think the other person had sprayed a certain portion of a large clump and would leave it unsprayed. In this way, it was found that the Ribes were not all sprayed.

It has been found unnecessary and impractical to have the crew foreman checking behind the crew all of the time. For the first few days until each member of the crew became very familiar with each species of Ribes present, the foreman checked very closely on most of the strips worked, but after they had developed an eye for Ribes, the foreman did not have to check more than one-eighth of the time. Checking by the foreman at all times was impractical:

(1) Because the distance between men was not so great but what all Ribes were readily seen even in very thick brush.

(2) Because the foreman knocked more or less of the spray from the Ribes thus decreasing the efficiency of the spray.

(3) Because the foreman's time was needed for other work.

The only need for checking by the foreman was to see that the men did not become careless in spraying too heavily, thus wasting solution, or in spraying too lightly, thus getting a poor kill.

During the time thus given to the foreman he was keeping records, cutting trails, mixing solutions, keeping up the supply of dry chemical, moving filling stations, and laying out strips.

Records were kept on regular Daily Crew Record forms for Chemical Eradication. Besides this, notes were taken on any special difficulties encountered and also on method suggestions offered by the crew.

Trails along the creek and from roads to creek were found to be indispensable. Most of these were made by the foreman. Trails saved considerable time for the crew men on coming back to refill tanks and

for the foreman in getting the dry chemical to the filling station.

The method of mixing solutions was as follows: Two copper boilers capacity 15 gallons each, and 1 washtub, capacity 16 gallons, were used. $NaClO_3$ was weighed out in 32-pound lots. For weighing it was found most convenient to use a large galvanized bucket and a 50-pound capacity spring scale. After each lot was weighed out, the chemical was placed in a cotton flour sack as the most convenient means of carrying it to the filling station. One 32-pound lot was dumped into each boiler and 12 gallons of water added and thoroughly stirred with large wooden paddles. When cold water from the creek was used, the $NaClO_3$ took some time to dissolve. This was considerably hastened by continual stirring.

The foreman did most of this work after spraying operations on any one block got well under way.

A filling station is defined as that place chosen for the mixing of solutions, and hence the place the tanks were brought to be refilled.

The foreman while cutting trails selected places along the creek most convenient to the area being sprayed so that the least possible amount of time was consumed by the crew men in actual traveling back to the filling station when their tanks were empty. These filling stations were located on an average of about 3 chains apart along the creek. It was necessary for the foreman to watch the spraying and to determine how much solution would be necessary to spray all Ribes half way to the next filling station. As soon as enough solution was mixed at that station and one container was emptied, it was taken to the next station where more spray was mixed up. In this way a negligible amount of time was taken from actual spraying time for the moving of equipment from one station to another.

The general method for laying out the area was described in section IV of this report.

In laying out the strips therein described a compass was used to get the lines as nearly parallel as possible. The foreman laid out enough string lines ahead of the crew to keep the crew busy approximately one-half day. In this way, the crew did not have to wait for the area to be laid out except at the beginning of the first block. The length of the strips were measured by pacing while laying the string lines.

VI. Suggested Improvements in Equipment:

(a) Something should be done to see if the ridge which holds the bottom of the tank to the sides can be removed by some different method of welding, such as used on last year's tank.

(b) Mr. Ross suggested that a piece of canvas might be laced tightly around spray tanks, thus forming a cushion so that the tank will ride

W.693. The start of the day's work. Removing chemical from kegs, weighing it.

W.671. Charging chemical into knapsack sprayers after solution has taken place.

W. 672. The crew loading up with a charge of chemical.

W. 687. Another view of the crew at work.

easier on the back.

(c) The shoulder strap rings on the bottom of the tanks should be set farther apart.

(d) Shoulder straps should be a little wider.

B. Working Plan Used With Power Equipment

1. Equipment Used:

(a) Pumpers.

(1) Pacific marine pumper consisted of a 1-1/2-H.P., air-cooled, one cylinder gasoline motor, mounted on a base with a standard Oberdorfer type A, form YZ#9 single stage pump, of bronze construction.

The gas tank was mounted overhead and the dry cell batteries were in a separate box. The pump was equipped with an adjustable by-pass in order to equalize the pressure regardless of the number of nozzles which were open. The pressure was maintained between 75 and 90 pounds.

The whole unit including the battery weighed a little over fifty pounds.

(2) The Ross pumper was a modification of the Ross Fire-fighter, and consisted of a 4-horsepower, 2-cylinder, thermosyphon cooled, gasoline motor mounted on a base with a specially designed double stage gear pump of monel metal construction.

The battery was a standard 6 volt water-proof, dry-cell, concealed with the gas tank in the base which is of light but strong metal construction.

The pump was equipped with an adjustable by-pass so that a constant pressure between 175 and 200 pounds was maintained. The weight of this unit was 96 pounds complete.

(b) Other equipment.

Fifty feet of 1" heavy canvas hose. (This was found to be inadequate to handle pressures obtained by the Ross pumper). One hundred feet of 1" pressure rubber hose. (This was found to be too cumbersome and unnecessary even for main line). One hundred feet of 1/2" pressure rubber hose which was used in all later experiments as main line. Three hundred feet of 3/8" and 100 feet of 1/4" pressure rubber hose which was used as laterals in four sections, 100 feet to the section with a nozzle on the end of each section.

The nozzles first used were Vermorel type of spray nozzle, but later was exchanged for a combination of that type and the extensions

and nozzles used in hand spraying.

Two copper wash boilers, one galvanized tub, pails, gallon measures, and tools necessary for handling the power equipment made the balance of the equipment.

II. The spray used for these experiments was water.

III. Personnel of Unit:

(a) The foreman was in charge of whole unit and also laid out the area to be sprayed, helped keep the hose lines straight and move equipment, and kept records.

(b) The mechanic ran the motors, kept the tank filled with spray, helped move equipment and pick sites for pumping stations.

(c) Four crew men did actual spraying and helped move equipment.

IV. Laying out Area for Spraying:

(a) The plots on Merry Creek, Clarkia, Idaho, were chosen for this experimental power spraying for the following reasons:

(1) The first two blocks had been sprayed with hand sprayers the year before and interesting as well as valuable comparisons could be made. The chemical that had been used the year before had not been effective enough to make any difference in the actual spraying data.

(2). Good facilities were available for meals and lodging.

(3). This area was about as difficult as any that will be run up against in future eradication.

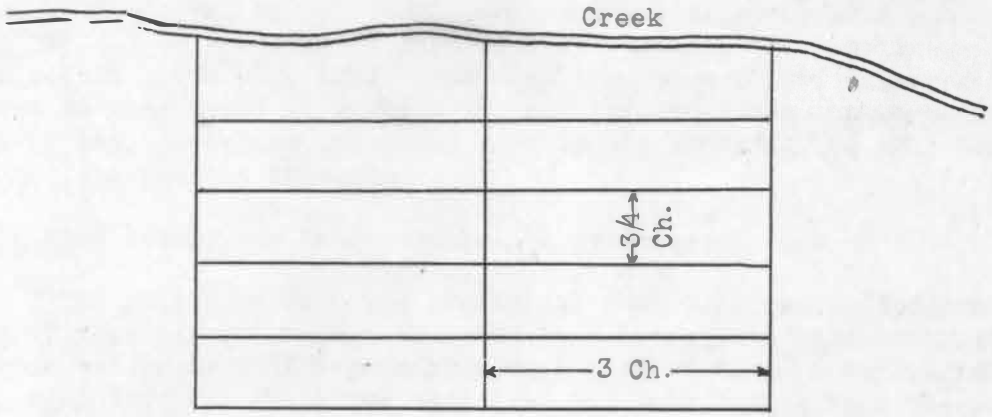
(4). This area had already been blocked off in 1/8 mile blocks.

(b) Methods used for laying out strips:

(1). Parallel strips 50 ft. wide were laid out perpendicular to the drainage by the foreman, using strings as boundaries.

(2). Where just a narrow strip along the creek had to be sprayed the strips were laid parallel to the creek.

(3). On wider drainages the best system of laying out area was worked out the last day of work at Clarkia, Idaho. This consists of laying out strips 3 chains wide perpendicular to the drainage, then sub-dividing into 3/4 chains strips parallel to the creek as in the following diagram:



V. Handling Unit over Area:

(a) When strips are laid out perpendicular to the drainage:

The pumping station was set up on the creek near the center boundary dividing two strips. The foreman laid out 100 ft. of main line from the engine, placing the "T" in the center of strip No. 1, then each crew man brought his 100 ft. of lateral hose to the "T" where it was coupled on the main line. At the "T", the crew men took their interval and went into the creek where they began spraying after the mechanic had been notified that all was in readiness and had begun the pumper.

Each crew man sprayed backing up, and pulled his hose line after him. He did not stop at the "T" but continued until the extremity of the strip or the end of the hose line had been reached.

The crew as a whole, worked as nearly abreast in line formation as the brush conditions would permit, and since the strips were laid out about 50 feet (.75 chains) wide, each man was responsible for about 6 feet on each side of him.

When the end of the strip had been reached, the crew foreman signaled to the mechanic who stopped the pumper. The foreman then uncoupled the laterals and moved the "T" to center of strip No. 2 which was worked in the same manner as strip No. 1. In this way, 2 strips were sprayed before the engine had to be moved. When the strips were short, three could be worked before moving the engine. Since only 100 feet of main line were available, it is obvious that the longest strip which could be worked by this system was 200 feet.

For longer strips than this, a relaying system was used which is as follows:

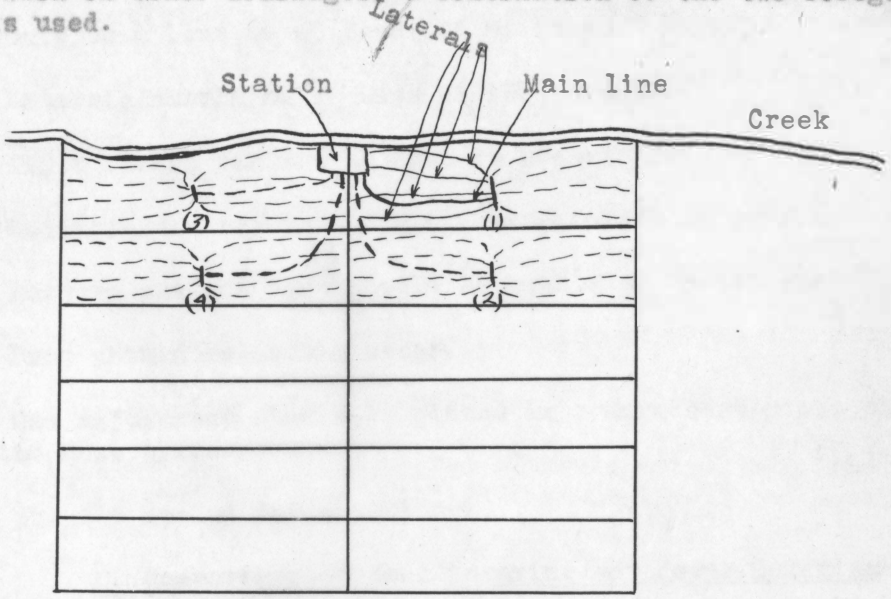
After the crew men had sprayed as far as the hose lines would allow on thru strips, they brought their nozzles together at a place convenient for all to reach where they took the nozzles off the lines and let the solution run into tubs. When the tubs were filled, the engine was moved to that point from which the rest of the three strips were then sprayed. Then the engine was moved back to the creek on the next three strips and the process repeated.

(b) When strips are laid parallel to drainage:

The procedure was very similar to that followed in the preceding portion of this report, except that the hose lines were laid parallel to the stream and instead of beginning spraying at station (S in diagram) and working away from it, the lines were laid out full length from the station

on one side where spraying was begun and everything sprayed up to the station. Then the main line was moved to the other side and spraying begun at the station and continued until the ends of the hose lines were reached. In this way, a maximum strip of 700 feet in length could be sprayed without changing filling stations.

(c) When on wider drainages, a combination of the two foregoing methods is used.



The area was laid out in strips as diagramed and the pumping station located between two large areas. The hose lines were laid out as position (1) indicates. Spraying was begun at the station and continued to the end of strip 1, then the hose lines were moved to position (2) in strip 2. After spraying that strip the hose lines were moved to positions (3) and (4) successively.

With the equipment used last field season, two strips from the creek were all that could be worked in that manner, but it is obvious that if 500 feet of main hose were used, 8 or 9 strips from the creek could be sprayed without relaying the water. There are very few drainages where Ribes are very concentrated, that could not be reached with that length of main line.

VI. Suggested improvements on equipment

(a) Couplings, Standardized-quick coupling on the pump as well as on the hose lines.

(b) An improved T be made for use should be a five-way T reducing from 1/2" to 1/4".

(c) An improved nozzle should be light, strong, fitted with a trigger valve, and 24" extension. Nozzle should have a finer hole.

(d) A suitable stretcher should be made for carrying pumping units.

(e) Substantial tool box be made with handles for carrying.

(f) Main hose line be ½" hose put up in 100' lengths.

(g) Laterals should be ¼" hose of 100' length.

(h) Finer screen for intake hose is necessary.

(i) Motor should be about 3 H.P., air-cooled, if possible.

(j) Battery and gas tank should be concealed in the base.

(k) Pump should be double stage.

(l) Gas adjustment should be placed in a more convenient position than that on the Ross pumper.

(m) Whistle needed for signaling.

C. Comparison of Hand Spraying and Power Spraying

I. Points in favor of hand spraying.

(a) Not much time wasted in handling equipment.

(b) Less solution wasted.

(c) Easier to spray the patches of Ribes when scattered and to spray small patches quite a distance from the creek.

(d) Less total weight in unit to be transferred from one place to another.

II. Points in favor of power spraying

(a) Total time to spray a concentrated area less than that taken by hand sprayers.

(b) Crew men carry no extra weight while spraying.

(c) Crew men more apt to stoop over to search for Ribes low under the brush. Tendency to take more care because weight is removed.

(d) Crew men not so apt to willfully waste spray because they have no special incentive to use up solution.

(e) Heavy concentration can be sprayed nearly as rapidly as the scattering patches.

III. Possible working plans for 1928 using a combination of hand and power spraying.

(a) The territory will have to be gone over quite thoroughly before the crew begins work, and the territory blocked off according to the means by which it will be sprayed. That is, the area near the creek and especially the very heavy concentrations will be worked with power sprayers while the patchy type especially those at some distance from the creek, and the isolated clumps of quite heavy concentration either near or at some distance from the creek will be worked with hand sprayers.

(b) Plan No. 1. This plan would be used in drainages such as the East Fork of Potlatch Creek where there is a very wide alluvial bottom with many Ribes. This would mean staying in one place for some time.

This plan calls for an eleven-man crew as follows:

(1) Foreman to be in charge of whole unit, camp, and all equipment. He would keep the camp supplied with equipment and chemical. He would also keep and analyze records.

(2) Assistant foreman to be in charge of power unit who helps to move and keep hose lines straight, keeps crew records, and lays out territory for spraying.

(3) Assistant foreman to be in charge of hand spraying. He would be one of the spraying crew when not occupied laying out the area and keeping records.

(4) A mechanic to look after the care and running of the pumping unit as well as mixing up solutions to keep the pump supplied.

(5) Crew men.

(a) Five men to handle hose lines and to do the actual spraying.

(b) Two men to spray with hand sprayers.

This plan calls for the unit to be equipped with ten hand sprayers so that in case of engine trouble, the hand sprayers could be used by the whole crew.

(c) Plan No. 2. This plan would be used on areas such as are found on the South Fork of Reed's Creek where heavy concentrations of Ribes just fringe the actual streams with scattering Ribes on the side streams.

This plan calls for a seven-man unit as follows:

(1) Foreman to be in charge of whole unit, to keep up supplies, to help in laying out the territory, to keep and analyze records.

(2) Assistant foreman to be in charge of actual spraying operations.

(3) Mechanic to be in charge of care and running of the power unit and to mix up solutions while the power sprayer is being used. He would mix solutions, lay out area and cut trails when hand spraying is being done.

(4) Four crew men.

In this plan the crew would use power equipment until they had covered a fairly good sized area, then they would clean up the fringes and outlying sections with hand equipment. Thus they would have to be equipped with eight hand sprayers.

D. General Suggestions

I. Whistle and signaling system

It was found to be very unsatisfactory to signal by vocal means.

While the engine, (especially true in the case of the Ross pumper), was in action, the mechanic could not hear the foreman's signals. If a shrill basket-ball whistle were used, a satisfactory signaling system could be worked out.

II. Checking

(a) From experience gained in the small amount of checking for missed Ribes done by the crew this year, I would say that after the crew has been spraying for about a week, it would be valuable for this same crew to spend about one day checking the first work done. In this way, the crew men themselves will get a chance to see just where missed Ribes or missed parts of Ribes are located.

(b) Suggested data to be taken.

(1) Location of undefoliated stem.

(a) High in brush (over 3 feet).

(b) Low in brush (under 3 feet).

(c) In the open.

(d) Under windfalls or logs.

(2) Classification of missed Ribes.

(a) End of stem.

(b) One-half of stem.

(c) Whole branch or stem.

(d) Whole bush.

III. Assistant foreman should be permanent and not appointed each day as done last field season.

E. Tables and Maps

I. Legend for tables

(T). Fuel used in P.M. Pumper was made up ½ pint of oil to 1 gallon of gasoline.

(T). Fuel for R. pumper was made up 1/3 pint of oil to 1 gallon of gasoline.

P. M. stands for Pacific Marine.
R. stands for Ross.
All time recorded in terms of man hours.
*Spray used was fresh water.

Table No. 1

Daily Summary with Power Sprayer
Chemical Eradication Plots, Clarkia, Idaho

Date	Type of Pump -er	Total Time of Run		Interruption of Service				Area Worked		(T) Gals. Fuel Used	Working Pressure in Lbs.	*Gallons Spray Used
				Handling Equipment		Other Causes						
		Man Hrs.	Man Mins.	Hrs.	Mins.	Hrs.	Mins.	Block	Acres			
Aug. 15	P.M.	5	48	22	30	1	12	Preliminary		1/2	55	40
16	"	3	30	38	48	1	42	"	"	) 1	70	18
17	"	5	48	39	--	--	--	"	"	)	75	61
18	"	6	24	5	--	--	54	"	"	1/2	75	56
18	R.	3	36	25	--	--	30	"	"	1	175-225	44
19	P.M.	12	12	14	24	13	36	I	2.96	1/2	50-75	77
20	"	4	12	3	18	4	48	I	.54	1/2	50-75	32
20	R.	2	--	4	42	33	--	Trouble-	- -	- -	- - -	- -
22	"	13	48	6	50	12	22	I	3.5	1-1/2	175	105
23	"	16	36	15	24	15	--	II	1.2	1-1/2	175	151
24	"	7	24	4	08	27	52	II	.3	1	175	65
26	P.M.	19	--	11	36	9	30	II	1.5	1/2	75	152
31	"	3	24	2	54	25	30	VII	.62	1/2	75	25
Sept. 2	"	12	40	12	45	6	35	VII	.91	1/2	75	105
3	"	6	45	1	40	31	45	VII	.5	) 1/2	75	38
8	"	6	48	2	02	--	--	VII	.6	)	75	51

Table No. 2

Condensed Spraying Summary
Chemical Eradication, Clarkia, Idaho

Area Worked		Type of Pump-er	Working Pressure in lbs.	Gals. of Fuel	Gals. of Chemical	Total Spray Time		Interruptions of service: Handling Equipment		Interruptions of service: Other Causes	
Block	Acres					Hours	Mins.	Hours	Mins.	Hours	Mins.
Preliminary		P.M.	55-75	2	199	24	30	304	18	3	48
"	"	R.	175-225	½	44	3	36	25	--	--	30
I	3.5	P.M.	50-75	1	109	16	24	17	42	18	24
I	3.5	R.	175	1½	105	13	48	6	50	12	22
II	1.5	R.	175	2½	216	24	--	19	32	42	52
II	1.5	P.M.	75	½	152	19	--	11	36	9	30
VII	2.63	P.M.	75	1½	219	29	37	19	21	63	50

Table No. 3

Delivery Tests
Chemical Eradication, Clarkia, Idaho

Type of Pumper	Feet of 1" Hose	Feet of ½" Hose	Feet of 3/8" Hose	Feet of 1/4" Hose	Number of Laterals	Number of Nozzles	Gallons per Minute
P.M.	50	--	--	--	--	--	7-1/4
P.M.	50	--	300	100	4	--	5
P.M.	50	--	300	100	4	4	2-1/4
P.M.	50	--	300	--	4	4	2-1/2
P.M.	50	--	300	100	4	--	6-1/2
P.M.	50	--	200	--	4	--	(?)
P.M.	50	--	50	50	1	1	1/3
P.M.	50	--	50	50	1	--	2/3
P.M.	50	--	100	--	1	1	1-1/3
P.M.	50	--	100	--	1	--	3
P.M.	50	--	--	100	2	--	3
P.M.	50	--	--	100	2	2	1-1/4
P.M.	50	--	100	--	2	--	6
P.M.	50	--	100	--	2	2	1-1/2
P.M.	50	--	100	100	4	4	2-1/4
P.M.	50	--	100	100	4	--	6-1/4
P.M.	100	--	--	--	--	--	7-1/4
P.M.	--	100	--	--	--	--	5
P.M.	--	50	--	--	--	--	5-3/4
P.M.	--	100	300	100	4	4	1-3/4

No pressure recorded in the above tests.

Table No. 3 (cont'd)

Delivery Tests
Chemical Eradication, Clarkia, Idaho

Type of Pumper	Pressure in pounds	Feet of 1" hose	Feet of ½" hose	Feet of 3/8" hose	Feet of 1/4" hose	Number of Laterals	Number of Nozzles	Gallons per Minute
P.M.	--	--	100	300	100	4	--	4
"	--	--	100	300	--	4	--	4-3/4
"	75	--	100	300	--	4	4	1-1/2
"	75	--	100	100	--	2	2	3/4
"	---	--	100	100	--	2	--	4-1/4
"	75	--	100	200	--	2	2	3/4
"	--	--	100	200	--	2	--	3
"	75	--	100	100	--	1	1	1/2
"	60	---	100	100	--	1	--	2-1/4
"	75	--	100	50	--	1	1	1/4
"	60	--	100	50	--	1	--	3
"	70	--	100	200	--	3	3	1-1/10
"	45	--	100	200	--	3	--	4-1/5
"	75	--	100	250	--	3	3	1
"	50	--	100	250	--	3	--	4
"	75	--	100	100	100	2	2	9/10
"	60	--	100	100	100	2	--	2-1/3
"	75	--	100	50	50	1	1	1/2
"	70	--	100	50	50	1	--	1-1/2
"	75	--	100	200	100	2	2	9/10
"	60	--	100	200	100	2	--	2-1/5
"	70	--	100	100	50	1	1	1/2
"	70	--	100	100	50	1	--	1-1/4
"	75	--	100	100	100	1	1	1/5
"	75	--	100	100	100	1	--	9/10
"	75	--	100	50	100	1	1	1/4
"	75	--	100	50	100	1	--	1
"	80	--	100	--	100	1	1	1/4
"	75	--	100	--	100	1	--	1-1/10
"	75	--	100	--	100	2	2	1/2
"	60	--	100	--	100	2	--	2
"	75	--	100	--	50	1	1	1/4
"	75	--	100	--	50	1	--	1-1/3
R.	--	50	--	--	--	--	--	14
"	--	--	50	--	--	--	--	11
"	--	--	100	--	--	--	--	8
"	--	50	--	--	---	--	--	12-1/3
"	175	50	--	300	100	4	4	1-9/10
"	150	50	--	300	100	4	3	1-1/2
"	150	50	--	300	100	4	2	1-1/15
"	150	50	--	300	100	4	1	5/10

Table No. 4

Analysis of Power Spraying
Chemical Eradication, Clarkia, Idaho

Acres Worked		Gallons of Spray Used	Type of Spray Used	Man Spraying Time		Man Time Handling Equipment		Total Time	
Block	Acres			Hours	Minutes	Hours	Minutes	Hours	Minute
I	3.5	98	Hand	47	42	--	--	47	42
I	3.5	109	P.M.	16	24	14	12	30	36
I	3.5	105	R.	12	02	13	54	25	56
II	1.5	224	Hand	66	36	--	--	66	36
II	1.5	152	P.M.	19	--	11	36	30	36
II	1.5	216	R.	23	44	19	32	43	16

(a) Notes on the foregoing summary. The year before both these blocks were sprayed by hand sprayer. Figures for hand spraying were taken from 1926 notes.

On Block I. The Pacific Marine pumper was used before the Ross pumper.

On Block II. The Ross pumper was used first. By manipulation of the hose lines, one set-up used with the Ross pumper was eliminated when the Pacific Marine pumper was used. When the Pacific Marine pumper was used, the brush was very wet, thus saving much spray.

(b) Conclusions drawn from table.

(1). It is difficult to tell which of the power sprayers was the more economical, due to the fact that on both blocks less time and spray solution were consumed by the last sprayer used.

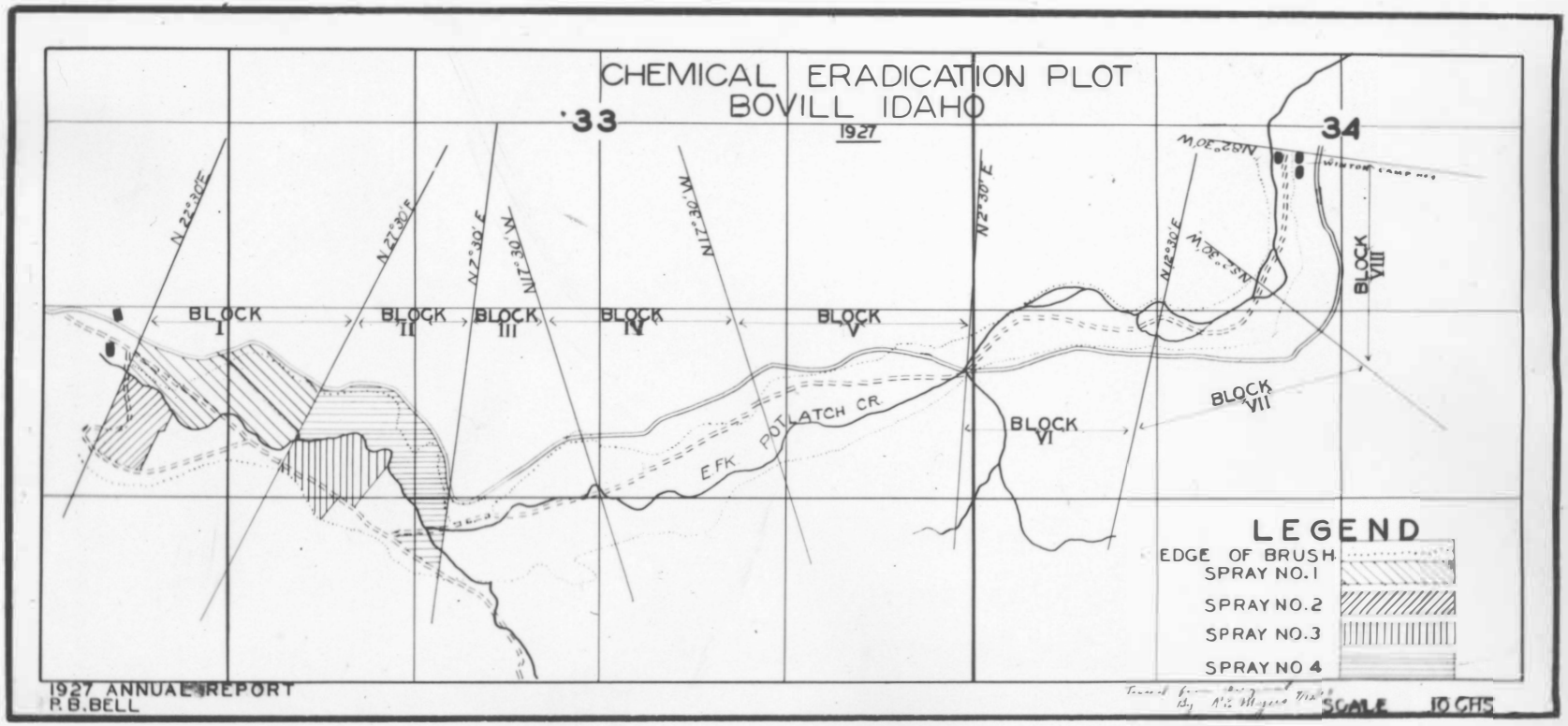
(2). This would indicate, as would be expected, that the second time through, the travel is easier and less spray is wasted.

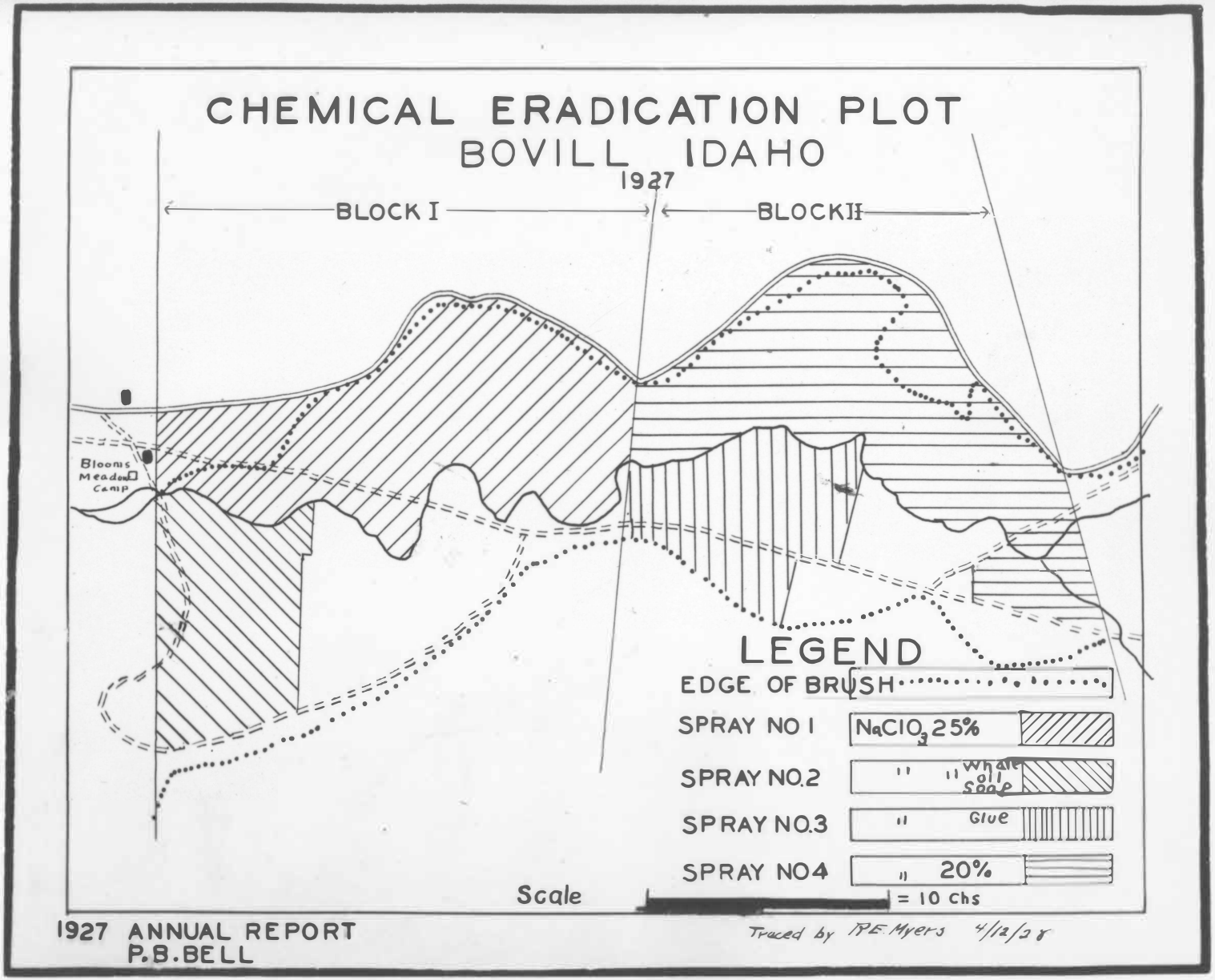
(3). Power spraying for these areas was profitable.

(a) Because though slightly more spray was used on Block I, the time saved would more than make up for the extra spray used.

(b) Because on Block II, time and spray both were saved by power spraying. The maximum time for power spraying was slightly over 2/3 that required for hand spraying.

(c) The cost of running pumper is very small.


CHEMICAL ERADICATION PLOT
BOVILL IDAHO
1927
33
34
N 22°30'E
N 27°30'E
N 7°30'E
N 17°30'W
N 17°30'W
N 2°30'E
N 12°30'E
N 5°30'W
N 82°30'W
WINTON CAMP NO 2
BLOCK I
BLOCK II
BLOCK III
BLOCK IV
BLOCK V
BLOCK VI
BLOCK VII
BLOCK VIII
E.FK. POTLATCH CR.
LEGEND
EDGE OF BRUSH
SPRAY NO. 1
SPRAY NO. 2
SPRAY NO. 3
SPRAY NO 4
1927 ANNUAL REPORT
P. B. BELL
SCALE 10 CHS


CHEMICAL ERADICATION PLOT
BOVILL IDAHO
1927
BLOCK I
BLOCK II
Blooms Meadow Camp
LEGEND
EDGE OF BRUSH
SPRAY NO 1
NaClO3 25%
SPRAY NO.2
" " whale oil soap
SPRAY NO.3
" Glue
SPRAY NO4
" 20%
Scale
= 10 chs
1927 ANNUAL REPORT
P.B. BELL
Traced by I.P.E. Myers 4/12/28

RIBES ECOLOGY

by

W. A. Rockie
Assistant Pathologist

I. Definition of the Experiment

The objective of this project is to learn more about why, how, when and where Ribes do and do not grow.

II. Methods of Study

It was found necessary to develop individual methods of work for each one of the several experiments in progress.

All data taken under the several studies were recorded on the following forms, BRC-WF #35 and #36:

RIBES ECOLOGY

General Description of Experimental Study Area

Name of Area_____ Sec._____ Twp._____ Range_____

Location_____

_____

Timber Composition (Species by %)_____

_____

Age Class_____ Exposure_____ % Slope_____

Eradication Type_____

Soil Conditions:

1) Down stuff - % Ground covered by (a. Raised logs_____
(b. Logs on ground_____
(c. Logs underground_____

2) Duff (depth, texture, moisture, etc.)_____

_____

3) Mineral Soil (depth, texture, moisture, etc.)_____

_____

Ground Cover:

1) Shrubs_____

_____% Ground Covered___

2) Herbs and Grasses_____

_____% Ground Covered____

Ribes (abundance by species)_____

Class of Burn (A - B - C)_____

Type of Burn (Crown, Brush, Ground, etc.)_____

Remarks_____

_____

_____

Recorders_____ Date_____

RIBES ECOLOGY

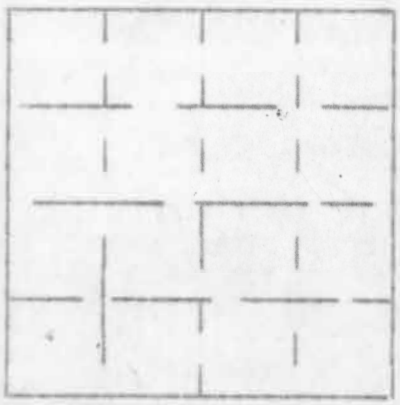
Name and Date of Burn or Area_____ Sec._____ Twp._____ Range_____

Location_____

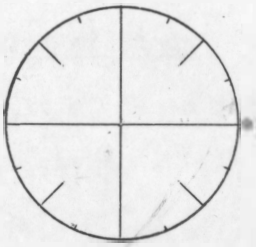
No. of Chain and Milacre_____ Age-class_____ Exposure_____

Mapped by_____ Date_____

Milacre Map



Compass Reading



Map Legend

_____

_____

_____

*Intensities of Burn
1. Unburned.
2. Scorched.
3. Duff partly burned
4. Total duff burn.
5. Hot burn.

Scale 1 inch = 3.3 feet.

Ribes Data

Serial No. of Ribes	Species of Ribes	Year of Germination	Ht. of Bush Feet	Live Stem of Bush Feet	Dead Stem of Bush Feet	New Growth Feet	No. of Fruits	Intensity of Burn*	% and Kind of Shade	Ground Cover Plants: Herbs or Shrubs	Ground Cover Plants: % Ground Covered	Special

III. Plot Index

The individual studies have been grouped into seven major divisions under the following headings:

A. Controlled Plot Study of Ribes
B. Results of Duff Disturbance
C. Restocking of Ribes after Eradication
D. Root Competition Study
E. Life Habits of Ribes
F. Ribes Seed Germination Tests
G. Leaf-area Live-stem Studies

Each of these major divisions is the subject of a separate report, dealing specificially with that experiment. These separates are submitted with this report.

IV. Results of Study

The applicable results of these studies are briefly as follows:

This story of Ribes history is built partly upon facts which are already proven and partly upon deductions to be substantiated by data which are not yet complete. Apparently, the story as given applies in general to all Ribes species of north Idaho.

The seeds of the native Ribes apparently lie dormant in the soil for long periods, probably remaining viable for as much as several hundred years.

Disturbance of the duff, either a partial destruction by fire or a mechanical disturbance, or any similar upsetting of natural conditions, is usually sufficient to bring new germination. Without the duff disturbance, however, germination of new seedlings is practically lacking.

The most frequent conditions under which these seedlings occur abundantly are following light ground fires, along new roads, trails and railroads, on the disturbed parts of logged areas, the site of burned brush piles, on camp-sites and on upturns.

Apparently the cause of no germination previously is the insulating temperature effect of the duff mantle. A definite, though as yet unknown, soil temperature and soil moisture condition is undoubtedly necessary for the seed germination. It is proven that the surface soil beneath the duff mantle is almost as cold at any time as the

ground water of the immediate vicinity, even when shielded from direct sunlight by only one inch of duff. It is probable that the soil temperature does not get sufficiently high for germination until the soil moisture content has gotten too low for germination. Insufficient actual data are available to prove this belief, but the meager data available indicate this to be the case.

It now appears quite conclusively that immediately after the duff disturbance, germination of a large amount of stored seeds occurs.

The mortality of these new plants is very high in the first year. As many as 212 seedling Ribes have been found growing on a single square inch of soil. Beginning in the third year, these Ribes start fruiting, reaching their maximum fruit production when they are from 5 to 10 years of age. During the first 5 years following the inception of the new generation of Ribes, they generally are the most abundant shrubby plant. During these years, the accumulation of duff is practically nil. During the succeeding 10 years, these Ribes produce and drop their seed to the ground, where most of them are believed to lie undisturbed. From the fact that these seeds seldom germinate on this soil in the early years of the plant, it appears possible that a long resting period is normal for the seeds of this group of plants. It may be, however, that the fact that germination of these new seeds is unusual, is due to the excessive droughtiness of this exposed mineral soil. The soil moisture under these conditions gets too low for germination much earlier in the season than does the normal forest soil, so the temperature-mositure relation previously mentioned may still be the cause.

From 10 to 20 years following the newly incepted Ribes generation, the other shrubs and the young conifers grow much more rapidly than do the Ribes, and many of the latter die. A much heavier autumnal mantle of foliage is deposited on the soil with each succeeding year, and the seeds which have been dropped for several years past and which the growing Ribes bushes are still dropping, are covered with the beginning of a new duff mantle.

By the time 30 years have passed most of the Ribes have ceased to live, except along drainage channels, and a fairly heavy mantle of duff now covers the ground. Constantly increasing shade brings a constantly decreasing number of Ribes, so that in dense timber stands of 30 years and older, practically no Ribes remain. In stands of all ages the old Ribes bushes may still persist in the openings and along drainageways. The oldest native Ribes bush that has yet been recorded in the West was about 42 years of age. This was reported from the eradication camps. The oldest bush encountered on the ecology studies was 40 years old. The new timber stand continues toward maturity with practically no Ribes present until fire, logging or some similar disturbance occurs to suffi-

ciently expose and warm the stored Ribes seeds. The seeds of any surviving Ribes bushes which still persist in this stand, drop onto the heavy duff mantle. The upper part of this duff is so loose that it gets too dry long before the surface duff gets sufficiently warm to germinate Ribes seeds.

With a new disturbance such as fire or logging, whether it occurs 25 years or 200 years later, this story is re-enacted. Apparently the succeeding Ribes stand is assured of successful perpetuation unless the stored seeds are all destroyed by a severe ground fire or by repeated fire on a given area. The absence of Ribes from any given area may be due to the fact that Ribes have never grown there, or that the seeds have been destroyed by fire.

V. Summary

Laboratory germination tests required a minimum of 8 months of dormancy before showing any germination.

Stored Ribes seeds which are in the basal portion of the duff in Ribes free timber stands may germinate after any disturbance of the duff.

This disturbance may be light or moderately severe ground fire, log-skidding, road-building, trail-building, upturns or any like disturbance.

Although the germination of stored seed usually occurs the first growing season after the duff disturbance, no iron-clad rule can yet be stated. If the disturbance occurs during early spring, germination may (1) follow almost immediately (2) it may hold over until the fall germinating season or (3) it may not occur until the following spring. On disturbances occurring during the summer, germination has occurred occasionally in September immediately thereafter, but usually not until the following spring. Fall and winter disturbances are generally followed by spring germination.

Studies to date show that more than 98% of Ribes seedlings which follow any disturbance come from seed located in the bottom 1/10 inch of the decayed duff.

Hand-pulling eradication of stream type results in a large number of new seedling Ribes on those areas of the duff mantle which were disturbed. This holds for both G. inermis and R. lacustre sites.

Bottomlands which were chemically sprayed show many new R. petiolare seedlings on the eradicated area.

The removal of the shade factor, without disturbing the duff, does not result in germination of Ribes.

Beneath a complete shade canopy, the disturbance of the duff does result in germination. Survival of seedlings under heavy shade is relatively low. Survival of seedlings in an open situation is (1) very high if on a moist site and (2) very low if on a dry site.

The maximum number of Ribes per acre in the life of the plant is the first year following duff disturbance for R. viscosissimum, and either the first or second year for R. lacustre.

Ribes of north Idaho begin fruiting in their third summer. General fruiting begins in their fourth or fifth summer.

CONTROLLED PLOT STUDY OF RIBES

I. Definition of the Experiment

A study of controlled field conditions designed to show whether or not viable seeds of R. viscosissimum are present in forest duff of different ages, or if the viable seeds of R. viscosissimum from which plants of this species normally develop on forest areas are recently deposited through some disseminating agency, such as wind, water, birds, and rodents. And by studying such plants as they appear and grow under the controlled conditions, to determine under which conditions the seeds germinate, and to what extent such plants survive to maturity. Also to determine the same facts regarding any other species of Ribes which may appear in the experimental plots thus established.

II. Types of Areas Selected

Potential R. viscosissimum sites were selected, taking care, in most instances, to select areas which were definitely free of Ribes plants, and had been free for at least several years. The basis used was as follows:

If R. viscosissimum was present in newly-disturbed adjacent areas, it was assumed that the adjacent forested areas not having these plants represented potential sites.

Within these limitations most of the experimental plots were placed as far as practicable from fruiting plants of R. viscosissimum. In most cases, the plots were placed in the center of an acre which careful search showed to contain no bushes capable of producing fruits, previous to the year when the experiment was established. Therefore,

the Ribes free area about the experimental plots usually ranged from one to several hundred acres.

The experimental plots were selected in several widely separated portions of the Idaho white pine region to make the study as wide in scope as practicable.

Insect killed and fungus killed areas of mature timber were desired for this study, but no satisfactory locations were found.

III. Methods of Study

A. Subdivisions of Experimental Unit.

An individual complete set of experimental plots consisted of 36 milacre units laid out as follows:

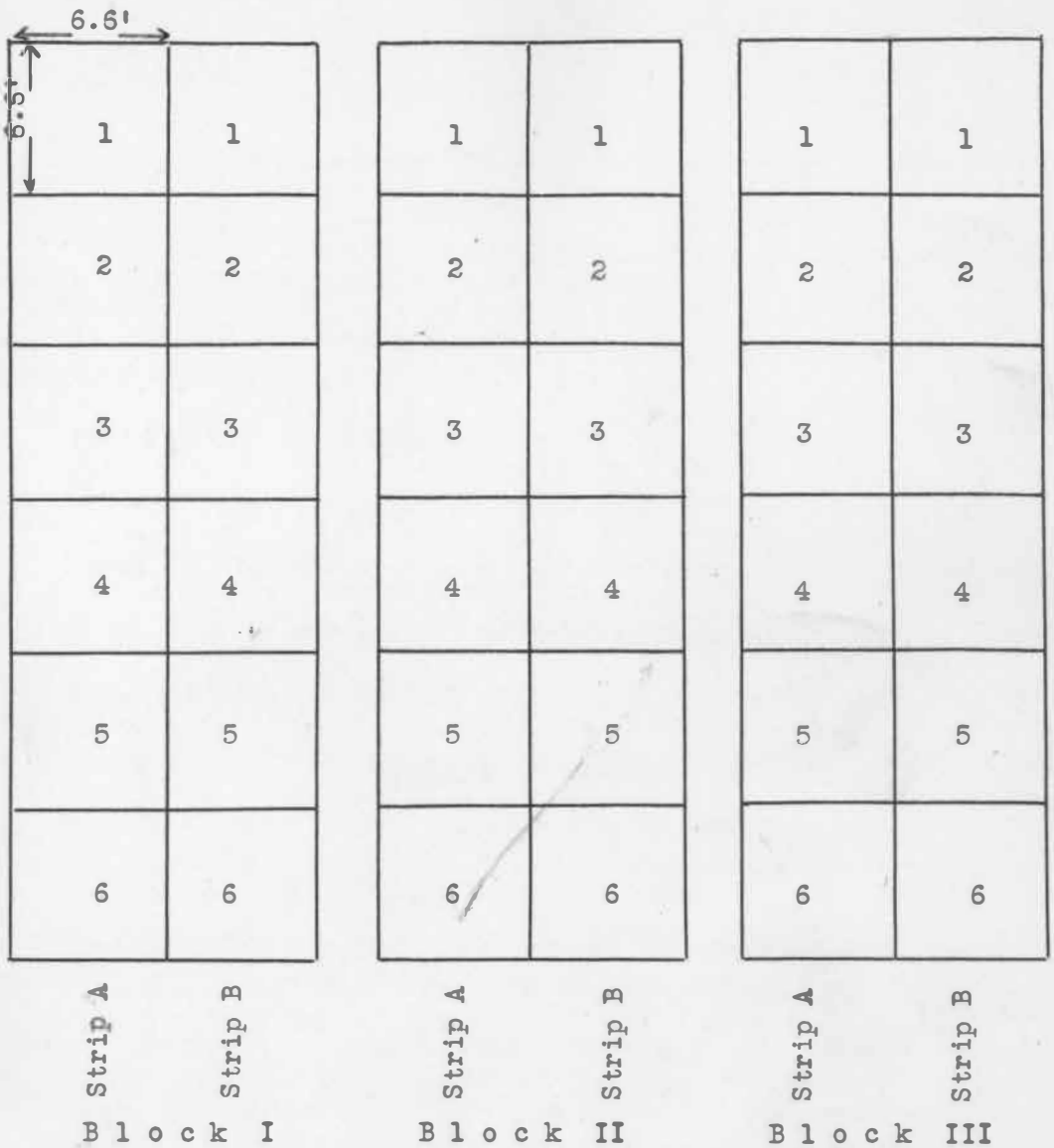



TABLE NO. 1